The Witcher 3: We find the GPU you need for your setup

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Welcome

Custom PC Issue 144

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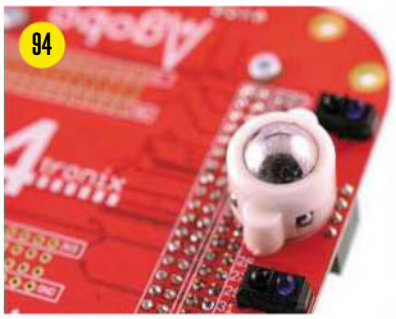

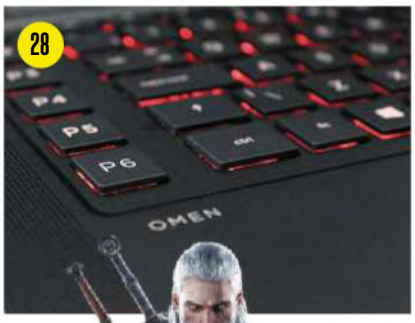

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BEN HARDWIDGE / FROM THE EDITOR

INTEL ON TRIAL

Another quad-core Core i5 and i7? Yawn. Ben Hardwidge wants Intel to give him a CPU to get excited about

Intel's laurel wreath must be looking pretty tatty by now, worn down by years of having to support the weight of Intel's bored, expanding bottom. It's been over four years since the Sandy Bridge architecture wowed us with its high instructions per clock, low power consumption and extreme overclocking headroom. Since then, Intel's mainstream desktop CPU line-ups have just shuffled forwards a bit here and there, like children who really don't want to take part in school sports day.

We've been through Ivy Bridge, Haswell, Devil's Canyon and Broadwell now, and every time we've seen the same yawn-inducing products – a quad-core Core i5 chip and a similar Core i7 chip with a bit more cache and support for Hyper-Threading. We used to see a clock-speed bump too, but even that seemed to disappear with the Broadwell launch. The rumours point to a similar CPU line-up with the launch of Skylake too, albeit with support for a few new features such as DDR4 memory.

That isn't to say that Intel hasn't made more powerful CPUs elsewhere. We now have a proper 8-core CPU, and 6-core CPUs have been a part of the company's LGA2011 lineup for a while now. But these CPUs are too expensive for most people and, given that Intel released its first 6-core chip, codenamed Gulftown, back in 2010 – five years ago – I'm amazed the technology hasn't yet filtered down to Intel's mainstream platforms.

It's difficult to get excited about a new CPU when it's really just the same idea Intel has been churning out for four years, but a tiny little bit better. As a point of comparison, four years is the same difference between Intel's single-core Northwood Pentium 4 and the Kentsfield quad-core Core 2 QX6700 – a massive difference. However far you overclocked a Northwood Pentium 4, you simply wouldn't be able to get the same performance as a QX6700, but you could overclock a Sandy Bridge CPU and get speed similar to a stock Devil's Canyon chip.

> Four years is the same difference between Northwood and Kentsfield

On the one hand, this situation is good for enthusiasts. It means we don't have to change our CPUs and motherboards as regularly, and we can instead focus our upgrade cash on a new GPU, a higher-resolution monitor or a higher-capacity SSD, all of which are arguably much more worthwhile upgrades than a jump from Ivy Bridge to Devil's Canyon.

But the frustrated enthusiast in me is crying out for Intel to give me something to get excited about. Sure, Intel has made progress on its integrated graphics system and power efficiency, and that's great for mini PCs (in fact, Iris Pro looks set to seriously challenge AMD's APU graphics), but who buys a multiplier-unlocked quad-core desktop CPU for the integrated graphics?

It doesn't help, of course, that AMD hasn't been able to challenge Intel with effective competition – it was arguably AMD's superb AMD64 architecture that prompted the aforementioned architectural jump between Northwood and Kentsfield. There's potential good news on this front if AMD's new Zen architecture can seriously challenge Intel next year, but in the meantime, Intel just seems to be mucking about.

We've seen transistors shrink from 32nm in Sandy Bridge to 14nm in Broadwell, so it isn't as though the technology isn't progressing; we should just be seeing better fruits from it. Yes, people could buy into the more expensive LGA2011 platforms instead, but it's just so disappointing to see Intel continually repeating itself in such a predictable manner on its mainstream platforms. Come on Intel, give me a reason to upgrade to your next CPU. CPC

Ben Hardwidge is the editor of Custom PC. He likes PCs, heavy metal, real ale and Warhammer 40,000. editor@custompcmag.org.uk @mandogfish

RICHARD SWINBURNE / VIEW FROM TAIWAN

WHAT'S AMD'S FUTURE?

Financial analysts reckon AMD could be bankrupt by 2020, but Richard Swinburne asks if the new Zen architecture could turn around its fate

A recent case study by investment firm Kerrisdale Capital claims AMD could be bankrupt by 2020. While I'm no financial analyst, the numbers with which Kerrisdale Capital works are public and its conclusions read as justified. However, the analysts haven't accounted for the recent reveals from AMD's 2015 Financial Analyst day, where the company's new Zen architecture looked like a positive step forwards, and they'll be arriving in 2016.

It's a whole new design with tonnes of cores, SMT (AMD's equivalent of Hyper-Threading), DDR4 support, a new high-bandwidth/low-latency cache system and a promise of over 40 per cent more instructions per clock. The current division between AM3+ and FM2+ sockets will also finally make way for a new, unified AM4 socket.

AMD is throwing *everything* behind Zen; the new architecture will power every chip from top-tier FX desktop CPUs down to ultra-mobile. However, while that's all good news, it doesn't represent the whole picture.

> The division between AM3+ and FM2+ will make way for a new, unified AM4 socket

GlobalFoundries (GloFo) will continue making AMD's APUs and CPUs, but since its spin-off from AMD seven years ago, GlobalFoundries has had problems reaching every new fabrication node. Its 32nm and 28nm processes were delayed, while its 20nm node has been skipped to make way for 14nm FinFet in 2016.

As part of the Common Platform Alliance, GlobalFo is in partnership with Samsung to develop 14nm chips, but a recent report by Business Korea relating to Nvidia's pursuit of Samsung's 14nm process states that 'a contract for new GPU foundries with Nvidia ... is also likely to decrease in terms of volume ... Nvidia has laid out a certain level of yield rate related to 14nm GPU foundry production'.

This translates into: '14nm FinFet yields currently aren't good enough for Nvidia's multi-billion transistor, high-performance GPUs.' If Samsung is having trouble and GlobalFoundries is in a development partnership, that's not good news. In the meantime, AMD has to build an ecosystem by courting motherboard and server makers to produce AM4 hardware.

Having worked in this industry, experience tells me these companies will err on the side of caution. Companies such as Asus and Gigabyte will jump at the chance to sell more motherboards, but the sales channels will be cautious to stock unproven products and, as their operations are based on previous sales (which were never great for FM1 or FM2), AMD will have to work hard to encourage them to buy in their products.

Beyond the chips, a recent report by Reuters states that AMD's chief executive, Dr Lisa Su, is apparently considering *every* possibility for AMD's future, as it begins reviewing whether to split itself up or spin off a business. One option being considered is separating its graphics and licensing divisions from its server and CPU departments.

GPU licensing makes good money and, according to several online reports from Korea, Samsung is looking for a GPU to replace ARM's Mali in its Exynos chips. By creating a new licensing company, AMD could formalise this process, pleasing investors, and Samsung could maybe fund some R&D too – both would be essential cash injections.

Back to ATI and AMD, then? Well, not quite. AMD's GPU tech can't walk too far given how tightly its GPU and CPU parts are interwoven in its APUs – even, reportedly, in Zen – so AMD must maintain a very close CPU and GPU relationship. Whatever happens, the next six months is likely to be quiet on the AMD front, but 2016 could be a wild year. CPC

Richard has worked in tech for over a decade, as a UK journalist, on Asus' ROG team and now as an industry analyst based in Taiwan @Bindibadgi

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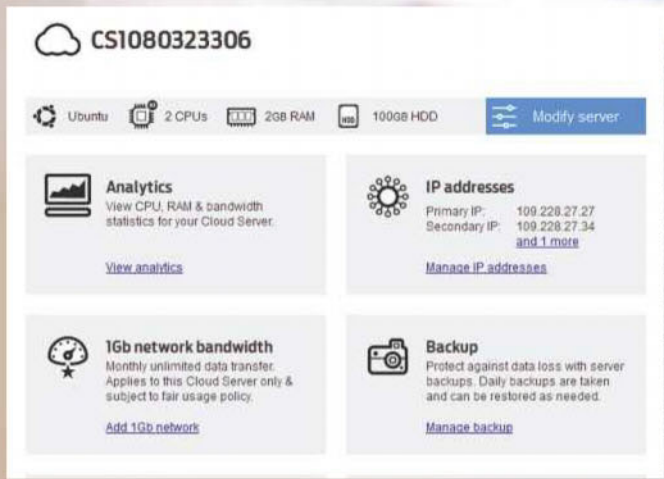

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Letters

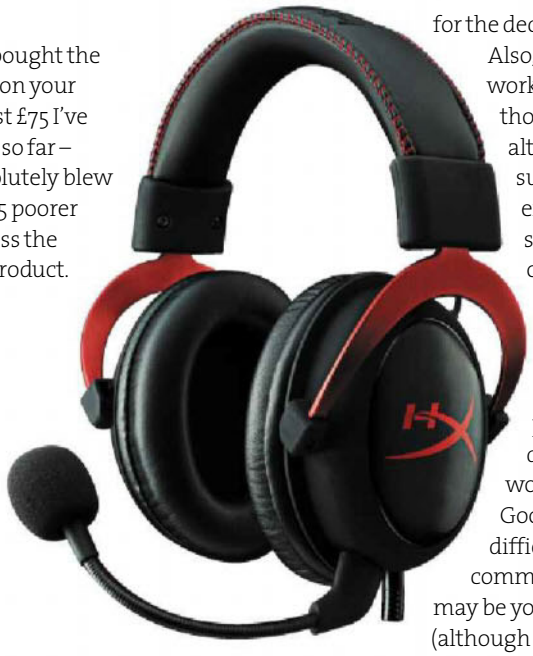
Please send us your feedback and correspondence to letters@custompcmag.org.uk

Living on Cloud II

I've just been out and bought the HyperX Cloud II based on your recommendation – best £75 I've spent in my (short) life so far – the sound quality absolutely blew me away. Here I am, £75 poorer but still trying to process the amazing-ness of this product. Keep up the good recommendations!

MATTHEW VAUGHAN

Ben: Yep, the HyperX Cloud II is an exceptional headset for the money, glad to be of service!



The HyperX Cloud II is a fantastic sounding headset for the money

Blushtucker trial

In response to Mark Gardner's letter in Issue 142, the best dust removal tool in my arsenal is my fiancées old blusher brush. The long handle and slim width make it perfect for getting into those hidden corners, and the combination of soft bristles with a high density actually means you collect the errant dust bunnies rather than just herding them around the case. Try one, you'll never use a paintbrush again!

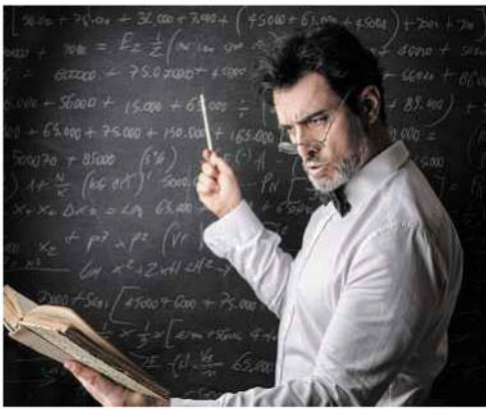
PHIL LOCKE

Commagain?

Glancing through the letter page in Issue 143, I was disappointed to see Ben's cavalier dismissal of Victor Wong's reasonable comment on the use of the comma in '2,400MHz'. For the record, the use of a comma in this context isn't a world standard – it's used in general literature in the English speaking world, but much of Europe uses a period for the thousand separator and a comma for the decimal separator. Also, many technical works omit the thousand separator altogether (quantity surveyors, for example, use a space and many other fields don't bother with separation at all). Corsair omits the comma on its product page, as does Scan, which would make a naive Google search difficult. Use of a comma within text may be your house style (although I would argue that it's not appropriate in all cases) but it has no place in a tech-spec description.

LEN GODDARD

As a maths teacher, I feel obliged to correct your statement, in response to Victor Wong, that putting a comma after the thousand column (and presumably after a million column and so on) is a style that is a 'standard one throughout the world when it comes to numbers'. The internationally accepted style is to either leave a space or to do nothing at all to denote groupings of 10^3, 10^6, 10^9 and so on.



Indeed, in most of Europe and beyond, the comma is actually used as a decimal point. I would guess that, like me, you learned your Maths in the 1970s, 1980s or early 1990s, as the National Curriculum has been clear about this for at least two decades. Only the USA and some of its neighbours cling to using commas (and Mexico only uses it for thousands, using an apostrophe for millions).

I must get out more!

RICHARD COLLIER

Ben: I consider myself humbly corrected, and I apologise for talking such rubbish, and you're right, I did learn maths in the 1980s and early 1990s. Annoyingly, I also already knew that various places across the sea use a comma for a decimal point – I'm not entirely sure why I said it was a 'world standard' – I obviously didn't have a fully functioning brain on that day. I'll discuss this point with our production editor over the next month, and you may (or

CORRECTION

In Issue 143, we incorrectly listed the manufacturer of the JetFlash 880 64GB USB drive as PNY when it's in fact manufactured by Transcend. Needless to say, this correction doesn't change the drive's score, meaning the Transcend JetFlash 880 64GB USB retains its well-deserved Custom Kit award.

> The best dust removal tool in my arsenal is my fiancée's old blusher brush

may not) see a change in our style on memory frequencies in the next issue.

Bay of light

Firstly, thanks for a great mag, but in Issue 142, James Gorbold's article on the ability to now abandon 5.25in drive bays is, in my opinion, just daft. So what do I do with the multitude of discs I own? Do I just bin them because tech 'has moved on.' Oh, we all need Windows 10, do we? What's happened to the way tech is evolving ? I've been involved in the tech service business for decades, first working on videos and TV sets in the 1970s, and now working on PC builds and repairs. We will need 5.25in drives for years yet, and contrary to James, I believe most PCs I see still have them.

DR J NEWMAN

Ben: I agree with you. I recently bought a Fractal Define R5 over a comparable NZXT chassis simply because I want to be able to play my old media without having to use an external drive. It took a good 30 years for floppy controllers to disappear from most motherboards, and I suspect there will be similar support for 5.25in drive bays and optical media for many years to come. Not everyone has the same needs though. If you simply don't use optical media any more, I can see why it would annoy you to waste precious space on accommodating them.

Cheaper suppliers?

I would firstly like to say that I thoroughly enjoy **Custom PC** magazine. I particularly find the Elite section helpful when considering upgrades or system builds. However, out of curiosity, I decided to price up a 4K 6-core workstation (Issue 142, p66 July), as I've often found items cheaper on Amazon. In this instance, the cost of like-for-like items totalled £2,186, a saving of £129 compared to your listed suppliers, which would leave you with enough spare cash to buy a Creative Sound Blaster Z.

I understand you have an obligation to your advertisers, but surely you also have some obligation to your readers to at least state that items can be purchased cheaper elsewhere.

NATHAN EDEN

Ben: I'm pretty sure I've said this before, but I'll say it now just in case: we always encourage our readers to shop around and find the price and supplier that suits them – there's no reason why you have to use our supplier recommendation at all – you may well be able to find kit cheaper elsewhere.

We do sometimes list Amazon in Elite, but we usually prefer to list the tech specialist firms with whom we work closely. It's not so much an obligation to our advertisers as the fact that we really like these suppliers, and they often supply kit we review. It's not always possible for us to get hold of samples direct from manufacturers in time, and if a company supplies a product to us, it's only fair that we list it as the supplier. Also, companies such as Overclockers, Scan and so on actively support the PC enthusiast community, putting on events, offering support in forums and building great PCs. CPC

Optical media is likely to stick around for a good few years yet

Twitter highlights

Follow us on Twitter at @CustomPCmag

kajun_cheng Great issue of @CustomPCMag this month. Off to build my own hard-line build now thanks to the guide!
Ben: Excellent, good luck with it!

ghalfacree Hey, @CustomPCMag: can you let reader Julian Vicari know that he's wrong? A nut is a sub-type of fruit, comprised of a hard shell and seed!

daunorubicin @ghalfacree @CustomPCMag agree, nuts are a type of fruit. Peanuts on the other hand are not nuts

Edamski88 glad to finally see you've done a speakers lab test! Bought the AE Aego at Christmas and it's a fantastic bit of kit top work!

PedroThePrtoRcn I was reading your latest issue at work earlier and noticed that AMD is releasing chips in the past.
Ben: Argh!

WHEN'S THE NEXT MAG COMING OUT?
Issue 145 of **Custom PC** will be on sale on Thursday, 13 August, with subscribers receiving it a few days beforehand.

AUGUST 13

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TRACY KING / SCEPTICAL ANALYSIS

CAN GAMING HELP YOU LOSE WEIGHT?

Tracy King dissects the hyperbolic headlines and news coverage, and looks at the actual study, to find out

I'm a bit fat, particularly around the belly, a result of my sedentary lifestyle and plummet towards middle age. My sitting-on-my-butt time is mostly spent working, although I do still manage what some would call an 'unhealthy' amount of gaming, so it's reasonable to infer that at least some of my podge is down to being a gamer. But hooray! The cure is here, maybe, depending on disclaimers and sceptical analysis of the facts behind the hyperbolic headlines.

The headline 'Pass The Doritos, Scientists Develop Computer Game That Could Help Gamers Lose Weight' popped up on my news feed recently. The story opened with 'Psychologists at the University of Exeter and Cardiff University have published a study that demonstrates how a simple computer game can help people lose weight'. We're already in headline-contradiction territory here – 'people playing a simple computer game' is very different to 'gamers'.

In fact, the study's press release didn't use the word 'gamer' at all, and neither did the study. Eligibility for the study required that participants were aged 18-65, with a body mass index (BMI) of at least 18.5, who regularly ate specific snack foods and were identified as having some loss of control over eating. There's nothing about Minecraft tendencies or even computer literacy.

The story, which has been covered by Sky and others, has been distorted beyond the original study and, surprisingly, beyond the researcher's press release. Often overenthusiastic PR departments or scientists juice up their results to get news coverage for their funding body, resulting in an insidious press release recycling practice called 'churnalism'. But that's not what happened here. News outlets took a hopeful but conservative press release and jazzed it up into a bit of science fiction that, while on balance, is fairly harmless, doesn't really help people trying to lose weight (pass the Doritos is bad advice full stop).

In a spectacular twist of irony, one of the study's co-authors, Professor Chris Chambers, also co-authored a paper that investigated why popular science stories in the media were so exaggerated, and found that it may be because the original press releases themselves are exaggerated – you can read the study for free at **www.inscIout.com**. No wonder his own press release was so calm.

> After a few rounds I became obsessed with improving my speed and accuracy

So what of the claim that there's a computer game that can help you lose weight? Well, it's a 'sort of' game, and it maybe can help you control snacking (or rather, it had a positive outcome in this one trial and will therefore be undergoing more trials, which is exactly how science works). I spoke to the lead researcher, Dr Natalia Lawrence of the University of Exeter, and she sent me the game. It's a very basic set of photo flashcards depicting food or clothing.

The game mechanic is like the old Simon Says machine – you press a key when the box has a thin outline, and don't when it has a bold outline. After a few rounds (there are six in total), I became obsessed with improving my speed and accuracy (because I'm a gamer, duh). The idea is that your brain learns to associate certain foods with 'stopping' in the same way I associate the name Simon with mild panic and jeers from seven-year-olds. Obviously, my one playthrough didn't reduce my snacking propensity, but I'll keep an eye on this one to see how it pans out. Hmm, pans, I think I'm hungry. CPC

Gamer and science enthusiast Tracy King dissects the evidence and statistics behind popular media stories surrounding tech and gaming @tkingdoll

Incoming

We take a look at the latest newly announced products

AOC unveils FreeSync monitors

After impressing us with the cut-price performance of its 24in G2460PG G-Sync monitor in last month's monitor Labs test, AOC has now launched a FreeSync version of the monitor, called the G2460PF, along with another 27in FreeSync monitor called the G2770PF. The new monitors will be available in September 2015, and will cost £229 and £279 inc VAT respectively, with the former undercutting the cost of the G-Sync equivalent considerably.

EVGA ushers in new Platinum PSUs

EVGA has just expanded its SuperNOVA P2 power supply line-up to include 650W, 750W and 850W flavours, all supporting the prestigious 80Plus Platinum efficiency badge. All of the new PSUs are fully modular, include a ten-year warranty and are certified for use in both CrossFire and SLI setups.

AMD launches new GPU range

In addition to the Radeon R9 Fury X that we've reviewed on p18, AMD has also refreshed its GPU line-up with the new Radeon R9 300-series. Well, we say 'new' but the newly named GPUs still use the company's aging Graphics Core Next (GCN) architecture, using 28nm transistors.

At the top of the stack, without going into Fury territory, is the Radeon R9 390X, which has the same 2,816 stream processors split over 44 compute units of the 290X, but it's clocked at up to 1,050MHz. The GPU is also partnered with 8GB of GDDR5 memory as standard, hooked up to a 512-bit wide interface.

The next step down is the R9 390 (pictured), which has the same memory capacity and interface, but the GPU has 2,560 stream processors (again, like the R9 290) and is clocked at up to 1GHz. Finally, the Radeon R9 380 has the same 1,792 stream processors as the R9 285, but with a clock speed of up to 970MHz, and sports 4GB of GDDR5 memory hooked up to a 256-bit side interface. All the new GPUs also support DirectX 12, Mantle, OpenGL 4.5, Vulkan and OpenCL 2.

Sadly, samples weren't released in time for us to test them all thoroughly before we went to press, but we've had our first look at the R9 380 inside the Computer Planet Next Day 4000 i7 Gaming PC on p60. We hope to have a closer look at AMD's new GPU line-up in our next issue but, in the meantime, we currently recommend Nvidia's GeForce GTX 970 as our 2,560 x 1,440 card of choice, as the Radeon R9 290 is no longer available.

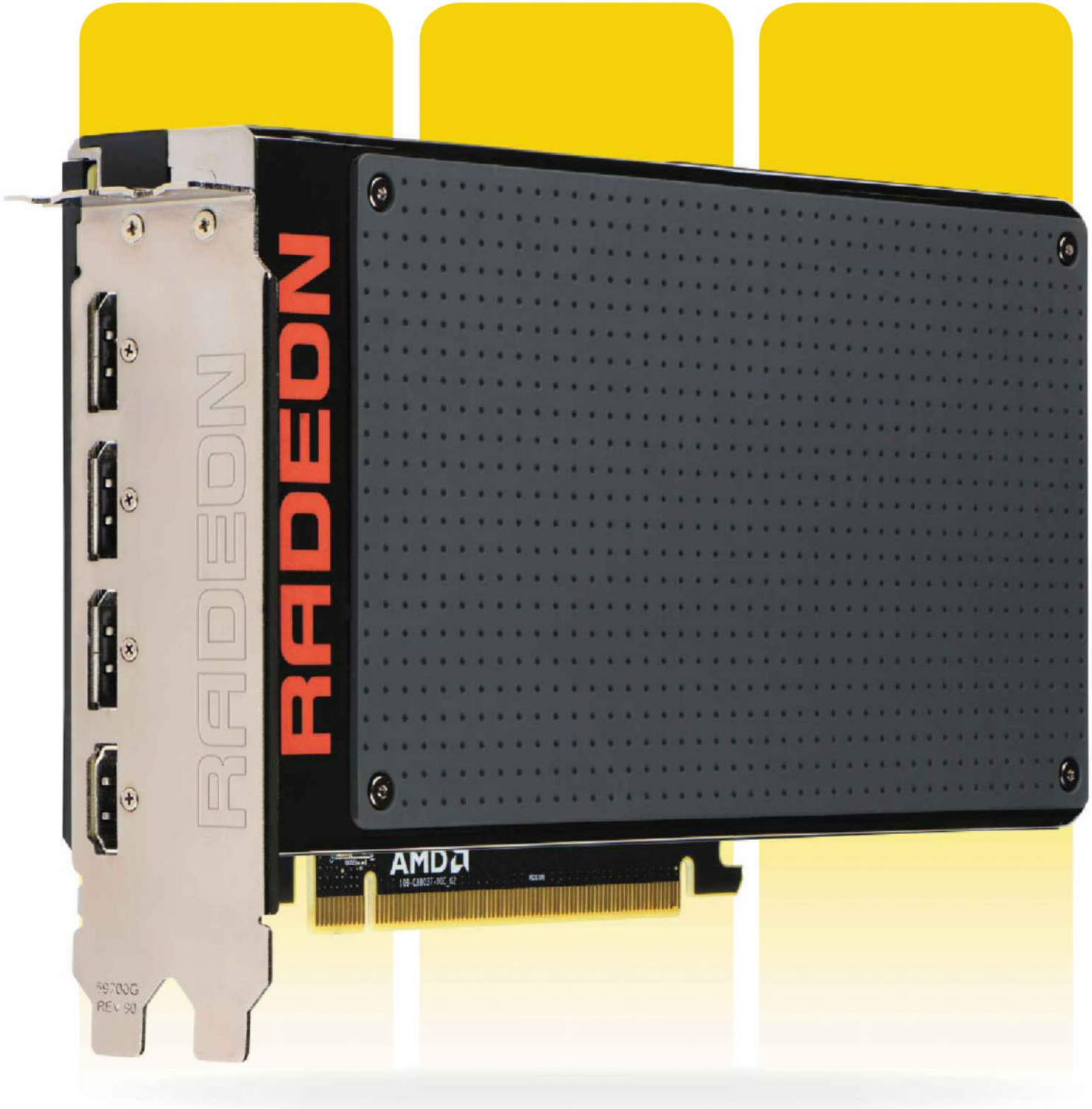
Intel Skylake rumours abound

Following last month's launch of Broadwell on the desktop – a launch that can be best summed up as 'meh', particularly as you still can't buy the chips anywhere – online rumours are circulating about Intel planning to launch its new unlocked desktop Skylake CPUs in August 2015.

Skylake is expected to follow Intel's tick-tock launch strategy, introducing an architectural overhaul that sees Intel's mainstream CPUs move to a new LGA1151 socket, while still using the 14nm process introduced with Broadwell. Manufacturers were keen to show off motherboards based on Intel 100-series chipsets at Computex last month, such as the pictured ASRock Z170 Extreme7. Intel hasn't officially confirmed a launch date yet, but we're hoping to get hold of some Skylake kit very soon. Watch this space.

Reviews

Our in-depth analysis of the latest PC hardware



Reviewed this month

HOW WE TEST
PAGE 32

NAS BOX

Synology DS715 / £323 inc VAT

SUPPLIER www.scan.co.uk

While most pricier NAS boxes offer stacks of drive bays, Synology's dual-bay DS715's key selling point is performance. Rather than sporting a single or dual-core CPU, the DS715 has a quad-core monster in the form of an ARM NEON-based CPU – the Annapurna Labs Alpine AL-314. This CPU has a frequency of 1.4GHz and has been designed to boost media transcoding performance – a job that's often slow on traditionally low-power NAS enclosures.

There's also 2GB DDR3 memory, plus dual LAN ports that support link aggregation for faster data speeds and better redundancy, although these features are more for business users. To keep your disks cool without making a racket, the DS715 also sports Synology's trademark 92mm cooling fan and its two tool-free hard disk trays have anti-vibration mounts too – plus they're held in caddies for easy removal and replacement. There are no front USB ports, but the DS715 does have two USB 3 ports at the rear, along with an eSATA port that allows you to connect more storage in the form of one its expansion units, boosting storage capacity from a maximum of 16TB to up to 56TB.

The DS715 has a quad-core monster ARM NEON CPU

Meanwhile, Synology's excellent operating system, DSM, looks and feels a lot like Windows, using icons and offering handy apps for download. The operating system currently stands at DSM version 5.2, and what's immediately obvious about this edition compared with older versions is the ease with which you can now share files and folders. Using Synology's MyDS Centre login feature, once you've signed up for an account, you can either access your NAS remotely online, or connect the NAS to your account to share your files too.

Sadly, the DS715 isn't currently supported by Plex, but you can still dish out media content using any one of DSM's servers, with the Video Station app allowing you to transcode high-definition media on the fly to iOS or Android devices running its DS Video Station app – an experience that's often very slow on Synology's cheaper boxes.

Speed-wise, the DS715's result of 12.2MB/sec in the NASPT photo album was slightly slower than the DS215j, albeit with the latter using a different DSM version. However, in the HD playback and record test, which is where you really notice the need for extra speed, it put in a storming result of 113MB/sec, which eclipsed every result in last year's NAS Labs test (see Issue 131, p56), while beating the DS215j by over 28MB/sec. It was also just as rapid in the file-copy tests, although the fan ramps up to audible levels under heavy loads, such as transcoding video.

Conclusion

The DS715 is a powerful NAS that copes admirably with demanding tasks such as video transcoding, although this speed currently has limited benefit, as Plex doesn't support it yet. We're hopeful the situation may change, though, and if it does, the DS715 will be the best dual-bay NAS enclosure to pair with Plex that we've tested. You pay a hefty price for this performance, though, so if media transcoding performance isn't a big priority for you, you can also access Synology's excellent, feature-rich DSM operating system on the much cheaper, and still superb, DS215j.

ANTONY LEATHER

SPEED	FEATURES	VALUE	OVERALL SCORE
33/35	31/35	21/30	85%

VERDICT

You pay a hefty price for quad-core power, and there's no Plex support yet, but the DS715 is a seriously powerful dual-bay NAS.

GRAPHICS CARD

AMD Radeon R9 Fury X / £510 inc VAT

SUPPLIER www.overclockers.co.uk

The R9 Fury X is AMD's new flagship graphics card. It features a brand-new GPU codenamed Fiji and it's also the first card to sport high-bandwidth memory (HBM). Liquid-cooled as standard, it's set to retail for just over £500 inc VAT, putting it in direct competition with Nvidia's GTX 980 Ti – a tough battle for sure.

Fiji is essentially an extended version of the Hawaii GPU used in AMD's R9 290 series. It uses the same Graphics Core Next architecture, but each of the four shader engines that make up the bulk of the pipeline now feature 16 Compute Units rather than 11, for a total of 4,096 stream processors and 256 texture units – an increase of 45 per cent over its immediate predecessors.

The big change is the move from GDDR5 to HBM

As such, the transistor count has increased to a massive 8.9 billion, with a die size of 596mm^2; after all, it's still made on the same TSMC 28nm process as Hawaii. The Fiji GPU is also clocked at up to 1,050MHz; AMD's quoted clock speeds are the maximum at which a GPU will operate within its thermal limits, but thanks to the liquid cooler, throttling won't be an issue with the Fury X.

Meanwhile, the GPU's front and back end are unchanged. At the front, the graphics command processor is paired with eight asynchronous compute engines, so graphics and compute tasks can be handled simultaneously. At the back, AMD has stuck to 16 render back-end units (four per shader engine), thus keeping the ROP count at 64.

Other features of this latest GCN architecture include TrueAudio, AMD's dedicated sound processor for in-game positional audio. There's also CrossFire XDMA, which means multi-GPU configurations can communicate directly over the PCI-E 3 bus, with no external bridge connector. As you would expect, the R9 Fury X supports DirectX 12 too, although not the full 12_1 feature level supported by the GTX 980 Ti. Still, it supports the major enhancements, including async shaders as well as the optimisations made for multi-GPU setups and multi-core CPUs.

The real newsworthy change, though, is the move from GDDR5 to HBM, as GDDR5 is too power-hungry at high clock speeds, limiting the power budget available to keep GPU performance high. GDDR5 memory also requires a lot of PCB space when you need multiple GDDR5 dies surrounding the GPU.

HBM directly addresses these issues. It uses smaller dies that, thanks to their extreme thinness, can be stacked on top of one another. They can also be placed much closer to the GPU using a layer of silicon called an interposer, through which the GPU and DRAM can be directly connected. This setup results in significantly lower power consumption, and the ability to use a much wider interface for greater bandwidth. HBM will also be adopted by Nvidia when its Pascal architecture launches.

The stacked dies are connected using a technology called through-silicon vias, or TSVs, which are tiny holes drilled through the silicon, filled with copper and joined with solder microbumps. This first generation of HBM is limited to 256MB dies and four dies per stack. The Fiji GPU can communicate with four stacks, so the R9 Fury X is limited to 4GB of VRAM, but AMD says that the increased bandwidth means the card still has the memory performance needed for high-detail 4K gaming.

Each stack has 1,024-bits of bandwidth via eight 128-bit channels (two per die) and, as Fiji has eight 512-bit memory controllers (two for each stack), the end result is a massive 4,096-bit wide interface. With such a wide interface, clock speeds can be drastically lowered, saving more power. Fiji's HBM is clocked at 500MHz, and thanks to its double data rate, its effective clock speed is 1GHz, giving it a total available bandwidth of 512GB/sec – far more than any other card around.

The use of HBM also means the total space occupied by the GPU and 4GB of VRAM is roughly three times smaller than on the R9 290X. Consequently, AMD has managed to cram all the parts onto a much smaller PCB – it measures less than 200mm long, although you have to contend with the 120mm radiator too.

The Cooler Master cooler makes contact with the GPU and HBM stacks via a copper baseplate. The tubing from the pump unit then passes through a copper heatpipe, which is soldered to a metal contact plate that draws heat away from the VRMs in the 6+2 phase power design, negating the need for a fan on the card itself. Meanwhile, the exposed tubing is 400mm long with high-quality sleeving, and the 120mm radiator ensures the best possible case compatibility.

AMD has clearly learned some lessons since the R9 290X too, as the card's build quality is great. The all-metal card merges black nickel-plated sections with soft-touch aluminium parts. The front faceplate can also easily be removed and replaced if users (or third parties) want to 3D print or make their own designs. There's a red LED behind the top Radeon logo as well, and just above the two 8-pin PCI-E connections is a set of eight LEDs that light up to indicate the current GPU load. These LEDs can also be set to blue, and there's a separate green LED to tell you when the GPU has entered its ZeroCore power state. Lastly, the Fury X has a dual BIOS switch, so you can have a stock speed and overclocked profile if you wish.

In terms of outputs, DVI support has been dropped – instead, the Fury X has a trio of DisplayPort 1.2 connectors with FreeSync support and a single HDMI 1.4a socket. The latter is an odd choice, though, as it means the card can't be used with the vast majority of 4K 60Hz TVs until DP1.2 to HDMI 2.0 adaptors become available later this year.

The Fury X sports a Cooler Master liquid cooler, featuring 400mm-long tubing with high-quality sleeving

Performance

At 2,560 x 1,440, the GTX 980 Ti is better in every test, with its biggest leads seen in Battlefield 4 and The Witcher 3. In other games, though, it leads by only a few frames per second. In many cases, you're unlikely to notice the difference, but many people will have been hoping for a better result from AMD's new best card. Only in two games at this resolution does the Fury X stay above 60fps, whereas the GTX 980 Ti manages this achievement in four of them. Overall, Nvidia's card is faster by 8 per cent on minimum frame rates, while the Fury X improves over the 290X by 35 per cent.

At 4K, though, that memory bandwidth comes into play and the Fury X is much more competitive; the 4GB of VRAM really doesn't appear to be a limit. In all our game tests, performance is practically identical.

Like the GTX 980 Ti, the Fury X offers playable frame rates in all games, although its Crysis 3 frame rate is right on the borderline of playability. At this resolution, it's faster than R9 290X by 38 per cent.

AMD has also reined in its power consumption, with our system only consuming 34W more power with the R9 Fury X installed, compared with the GTX 980 Ti, despite neck and neck performance at 4K. Temperature and noise are two more strong points. There's some slight pump noise and coil whine that's audible, but the fan is virtually inaudible even after prolonged load. The GPU temperature also peaked at just under 60°C while the fan stayed at its minimum speed of 15 per cent.

The Fury X isn't a great overclocker though. AMD says it's removed thermal and electrical limits by using a powerful liquid cooler and beefing up the power delivery, but the GPU core frequency still topped out at 1,130MHz, a boost of less than 8 per cent. The HBM can't be overclocked either, nor could we increase the voltage. The end result is only very small increases in performance – far less than what you can achieve with a GTX 980 Ti. On the plus side, power consumption only increases slightly and there's no noticeable change to heat or noise output.

Conclusion

The AMD Radeon R9 Fury X is a solid, well-rounded card in many respects, but it isn't without flaws, and it's not the Nvidia-crushing beast for which many had hoped either. The missing HDMI 2.0 support is an oversight, and its DirectX 12 support isn't fully featured either. Lastly, the Fury X is a pretty disappointing overclocker, operating at pretty much maximum speed out of the box.

On the other hand, it's really well made, exceptionally cool and quiet, and has lower power consumption than we expected – you can

/SPECIFICATIONS

Graphics processor AMD Radeon R9 Fury X, up to 1,050MHz

Pipeline 4,096 stream processors, 64 ROPs

Memory 4GB 1GHz (effective) HBM, 4,096-bit wide interface

Bandwidth 512GB/sec

Compatibility DirectX 12, Mantle, Vulcan

Inputs/outputs 3 x DisplayPort, HDMI

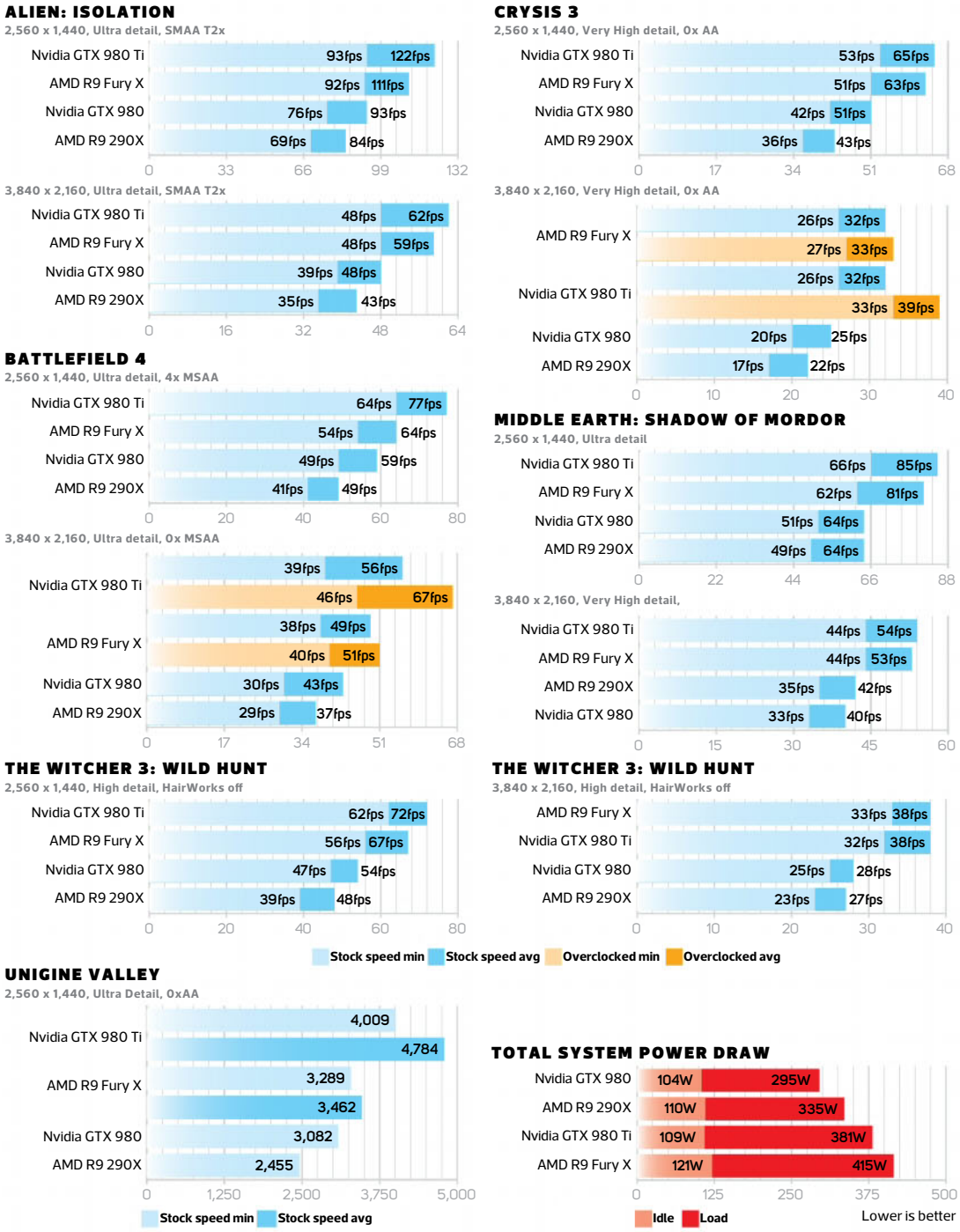
Power connections 2 x 8-pin, top-mounted

Size 195mm long, dual-slot

Radiator 120mm (400mm tubing)

easily run it in a high-end overclocked system that draws less than 500W from the mains. It's also pleasingly small – of course, much of the size is transferred to the radiator, but plenty of mini-ITX cases can still handle a 120mm radiator. The middling 2,560 x 1,440 performance is a shame, but at 4K, it's competitive enough to be award-worthy. That said, it faces a close battle with Nvidia's GeForce GTX 980 Ti, and it you can get a good deal on a custom-cooled, overclocked GTX 980 Ti, you'll end up with a better card.

MATTHEW LAMBERT



SPEED **37/40**

FEATURES **19/20**

VALUE **25/40**

OVERALL SCORE **81%**

VERDICT

Defeated at 2,560 x,1,440 by the GTX 980 Ti, but the Fury X is ideal for a quiet, 4K-capable gaming system.

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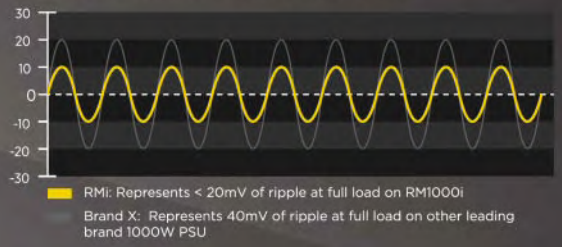

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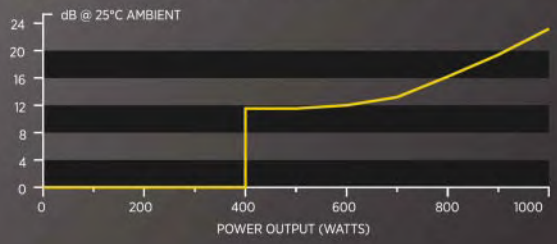

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CASES


CPU COOLING


DRAM


SSDs

AMD FM2+ APU

AMD A10-7870K / £105 inc VAT

SUPPLIER www.ebuyer.com

When it comes to budget systems, AMD's APUs have remained fairly competitive against Intel's offerings, mostly due to the latter's poor IGP performance. With half-decent Radeon GPUs under their hoods, 1080p gaming has certainly been possible with some of the more recent APUs, and AMD has now released another flagship to the A10 line-up – the A10-7870K.

Being a K-series APU, you can of course adjust the multiplier when overclocking; the non-K-edition version of the CPU was actually launched last year. The 7870K's direct predecessor, the A10-7850K, hit the shelves at the beginning of 2014, and the new APU, codenamed Godavari, is essentially a speed-bumped version of this APU.

It offers a 200MHz boost to the CPU frequency, rising from a base frequency of 3.7GHz to 3.9GHz, with a maximum Turbo frequency of 4.1GHz. There's a hefty 146MHz bump to the Radeon R7-based GPU too, rising from 720MHz in the A10-7850K to 866MHz in the A10-7870K.

Overclocking the A10-7870K was easy, as the vcore is set high by default

It still uses 28nm Steamroller cores too – the same cores found in the Kaveri chips – and the TDP remains the same at 95W as well. The A10-7870K also supports dual-graphics setups, whereby you can pair a discrete GPU in a hybrid form of CrossFire to boost 3D performance. However, as with the A10-7850K, the most powerful GPU you can pair with the new APU is a Radeon R7 250.

Like its predecessors, the A10-7870K has four integer units and two floating point units, so in some tasks, it's effectively a quad-core CPU, potentially giving it a lead over similarly priced Intel dual-core CPUs in multi-threaded tests. Thankfully, AMD has also introduced the APU at a lower price point compared with the launch prices of the A10-7800 and A10-7850K, both of which retailed for over £120 inc VAT at launch.

As a result, these top-end APUs were competing with fairly powerful Core i3 CPUs in terms of price, while much cheaper Intel CPUs could be paired with a discrete graphics card for not much more money.

At £107 inc VAT, the A10-7870K is already in a much better place, although it needs to be if early online benchmarks of Intel's new Iris Pro graphics are an accurate yardstick – for the first time, it looks as though Intel has a competitive integrated graphics system. Until Broadwell CPUs actually appear, though, AMD's top-end APUs are still the best bet if you want a CPU and GPU in one chip.

As with its Kaveri predecessors, though, the new A10-7870K will only work in a Socket FM2+ motherboard, so if you're upgrading from a Richland or Llano APU, you'll need a new motherboard too.

/SPECIFICATIONS

Frequency 3.9GHz
Core Godavari (Steamroller)
Manufacturing process 28nm
Number of cores 4 x physical
Cache L1: 2 x 96KB 3-way shared, 4 x 16KB 4-way, L2: 2 x 2MB shared
Memory controller Dual-channel DDR3, up to 2,133MHz
Packaging Socket FM2+
Thermal Design Power (TDP) 95W
Features SSE, SSE2, SSE3, SSE4a, SSE 4.1, SSE 4.2, 256-bit AVX, AESNI, PCLMULQDQ, AMD64, Cool'n'Quiet 3.0, AMD-V, MMX, FMA4, FM3, F16C, XOP, Turbo Core 3.0

Performance

Our test kit comprised 8GB of 2,133MHz DDR3 memory and an MSI A88X-G45 Gaming motherboard, while for the Intel Pentium G3258, we used its on-board Intel HD Graphics to obtain game benchmark results. As the FX-8370E lacks integrated graphics, we've only included it in the 2D benchmarks.

In all our tests, the A10-7870K was noticeably quicker than the A10-7850K, although the gains weren't massive. For example, the AMD reference score is only 3.5 per cent higher than our 7850K-based reference system. In game tests, the difference was only a couple of frames per second too, although this boost did equate to an increase of up to 6 per cent in some cases.

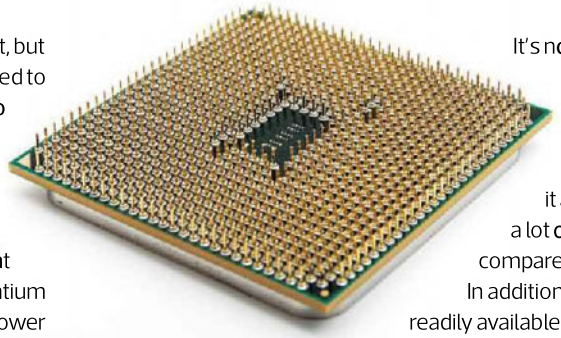
Comparison with the Pentium G3258 was interesting though. It's a much cheaper CPU, but it's clearly worth paying extra for the APU if you're looking for a cheap but well-balanced general-purpose PC. In all but the image editing test, where Intel's superior instructions per clock performance counts for more, the 7870K beat the Pentium. The latter was also dire in games, and its comparatively inferior GPU was shown up in our LuxMark OpenCL test too. It had a big edge in power consumption, though, with our Pentium test system drawing less than half the wattage of our AMD APU system under load.

Overclocking the A10-7870K was very easy, mostly due to the fact the vcore has been set fairly high by default, with CPU-Z reporting it to be a lofty 1.48V. Needless to say, you won't need to increase this vcore much to find a maximum overclock. We eventually settled on 4.6GHz using the default vcore, while also increasing the GPU frequency from 866MHZ to 900MHz. In fact, the vcore was set so high that at 4.4GHz we managed to reduce it to 1.44V and still have a stable system.

Once overclocked, the A10-7870K saw sizeable gains in all our benchmarks, with the system score rising from 58,106 to, 65,894 and 10 per cent or more being added to the minimum frame rate in the game tests too. The Pentium, which was overclocked to 4.2GHz, still held a

hefty lead in the image editing test, but despite huge gains itself, it still failed to topple the A10-7870K in the video encoding test.

When overclocked, the Pentium's on-board graphics were still awful in games too, resulting in a stuttery mess even at low settings. The overclocked Pentium again won out when it comes to power consumption though.



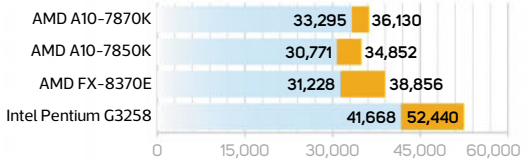
Conclusion

While there's nothing particularly new about the A10-7870K, apart from increased clock speeds, it enters the market at a more competitive price than its predecessors. It's noticeably quicker at stock speed than the A10-7850K, and the higher vcore allows for easier overclocking too. However, it also runs hot and consumes a lot of power, especially when compared with Intel CPUs.

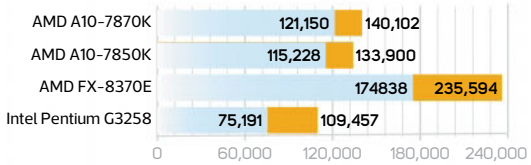
In addition, the A10-7850K is still readily available, and costs £10 less than the 7870K, so it's still a good choice for an all-purpose on a budget. The other factor, of course, is Intel's Broadwell and Skylake CPUs with Iris Pro graphics. At the moment, AMD's A10-7870K is the king of all-in-one chips, but it could soon be up against some very stiff competition.

ANTONY LEATHER

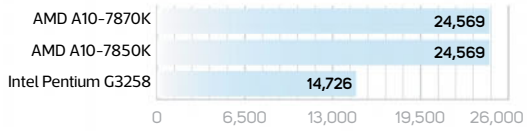
GIMP IMAGE EDITING



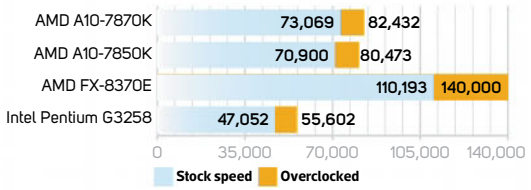
HANDBRAKE H.264 VIDEO ENCODING



LUXMARK OPENCL

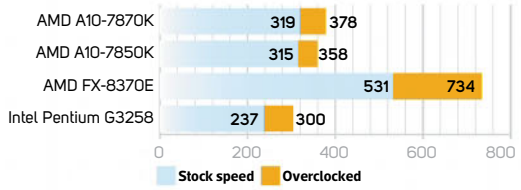


HEAVY MULTI-TASKING



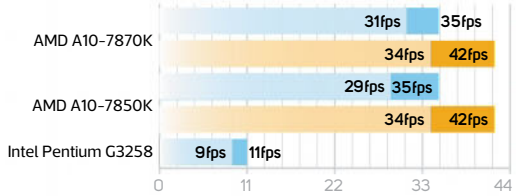
CINEBENCH R15

64-bit CPU Test



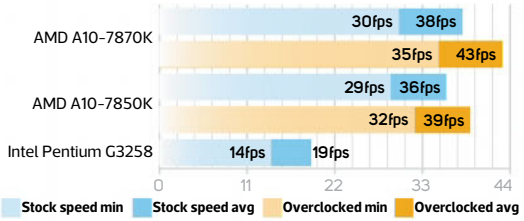
BIOSHOCK INFINITE

1,920 x 1,080, 0x AA, Low detail

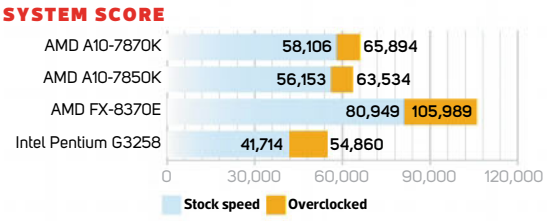


THE ELDER SCROLLS V: SKYRIM

1,920 x 1,080, 16 x AF, 0 x AA, Low detail



SYSTEM SCORE



AMD REFERENCE: 103.5%

SPEED 37/50 | FEATURES 13/15

VALUE 30/35

OVERALL SCORE 80%

VERDICT

A little quicker than the A10-7850K and easy to overclock, but not a lot else has changed.

FM2+ MOTHERBOARD

MSI A88X-G45 Gaming / £82 inc VAT

SUPPLIER www.box.co.uk

One of the main benefits of an APU system is its potentially small size, so full-sized ATX Socket FM2+ motherboards such as MSI's A88X-G45 Gaming often seem like a bit of a contradiction. However, there's a few reasons to consider this particular board. Firstly, it has some of the best power circuitry cooling of any Socket FM2+ motherboard we've seen, which is important if you're thinking of overclocking.

There's also not one but three 16x PCI-E slots that support three-way CrossFire, although the third slot is limited to 4x speed. Sensibly, there's also a large gap between the two top 16x PCI-E slots for airflow, plus a single PCI slot and trio of 1x PCI-E slots, one of which sits above the main 16x slot so it should always be accessible. That said, if you're building a system with two or more graphics cards, you're unlikely to do it with an APU system.

Of course, you can also pair AMD's APUs with discrete graphics cards in dual-graphics mode, using the on-board GPU and discrete GPU together. However, the fastest model that's compatible with this feature is the R7 250X, so sadly you can't pair an A10-7870K with an R9 270X for a free performance boost.

The PCB is peppered with useful tools

The PCB is peppered with useful tools and features too, such as five fan headers, power, reset and clear-CMOS buttons as well as an LED POST code display. The larger PCB has also enabled MSI to beef up the on-board audio, with an isolated area of the PCB dedicated to the audio processor, and a headphone amplifier thrown in too. This setup partners with the included Creative Sound Blaster Cinema software, which adds features with which owners of Creative sound cards will be familiar, such as Creative's Crystalizer and Smart Volume.

There are eight SATA 6Gbps ports too – more than you'll find on any AMD mini-ITX motherboard, although there are no other SATA or PCI-E storage options. The SATA ports are all mounted parallel to the PCB, though, for easier cable routing and the layout in general is excellent. There's plenty of room around the CPU socket, despite the large heatsinks, and MSI has made the most of the extra PCB real estate compared with a similarly priced Intel Z97 motherboard.

There's no on-board Wi-Fi, but you do get Killer E2205 Gigabit Ethernet. The rear panel also has the full array of video outputs, so if you're planning on using an APU now to save money, but plan to drop in a discrete GPU at later, the A88X-G45 Gaming should work with any monitor. The DVI port will work with 2,560 x 1,600 monitors and while any APU-based system would struggle at 4K in games, the DisplayPort output can certainly handle a 4K monitor.

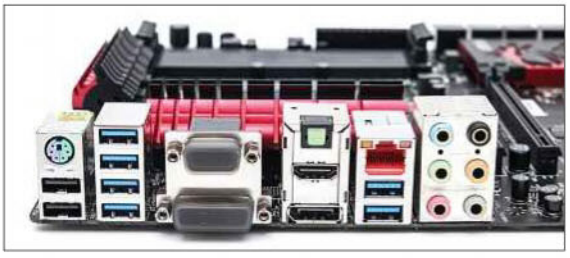
There are plenty of USB 3 ports available too. The rear I/O panel offers two ports via the A88X chipset, with a further two via a motherboard header, while a separate VIA VL805 controller ads a further four ports to the rear I/O panel. The USB 3 header is perhaps the only poorly placed object on the PCB; mounted at the bottom of the motherboard, it isn't ideally placed if your case's front panel cables are routed from the top.

Performance

Whether your APU is overclocked or not, MSI's EFI is excellent and is very similar to the EFI systems on its Intel motherboards. It's easy to set the memory frequency correctly (crucial on an APU system), and its visual fan control suite provides a welcome flash of colour too.

Using AMD's new A10-7870K (see p22), the A88X-G45 produced a total system score of 58,106, with the system drawing 128W under full load from the wall and 38W at idle. We then set about overclocking the APU, which proved to be easier overall than with the Gigabyte F2A88XN-WiFi we used in this month's APU feature (see p84) - the A88X-G45 Gaming happily pushed our APU to 4.6GHz with no additional vcore required. Beyond this frequency, the temperature quickly made the chip throttle.

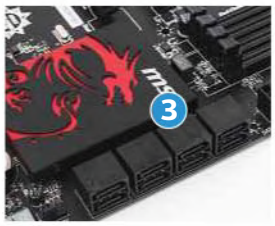
However, overclocking the on-board Radeon GPU wasn't quite so easy. The Gigabyte board enables you to alter the

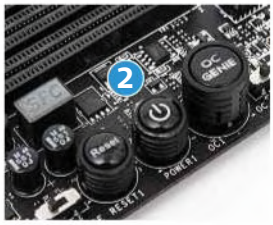


/SPECIFICATIONS

Chipset AMD A88X
CPU socket AMD Socket FM2+
Memory support 4 slots: max 16GB DDR3 (up to 2400MHz)
Expansion slots 3 x 16x PCI-E 3, 3 x 1x PCI-E, 1 x PCI
Sound Realtek ALC1150 8-channel
Networking Killer E2205 Gigabit LAN
Overclocking Base clock 90–129MHz, CPU multiplier 8–63x; max voltages, CPU +0.5V, RAM 1.8V
Ports 8 x SATA 6Gbps (A88X), 8 x USB 2, 8 x USB 3, 1 x LAN, 6 x surround audio out, line in, mic, optical S/PDIF out, 1 x HDMI, 1 x DisplayPort, 1 x DVI, 1 x VGA,
Dimensions (mm) 305 x 244

HOW WE TEST
PAGE 32





1. A large gap between the top two 16x PCI-E slots improves airflow
2. The board is peppered with premium tools, including on-board power and reset buttons
3. The total of eight SATA 6Gbps ports enables you to hook up loads of storage devices

GPU frequency in 1MHz steps, but the A88X-G45 Gaming only lets you increase the GPU clock in increments, usually between 20 and 40MHz. This system wasn't ideal for fine tuning, and we had to settle for a GPU clock of 918MHz, which is only one step up from the default 867MHz frequency, as the next increment of 975MHz proved too far.

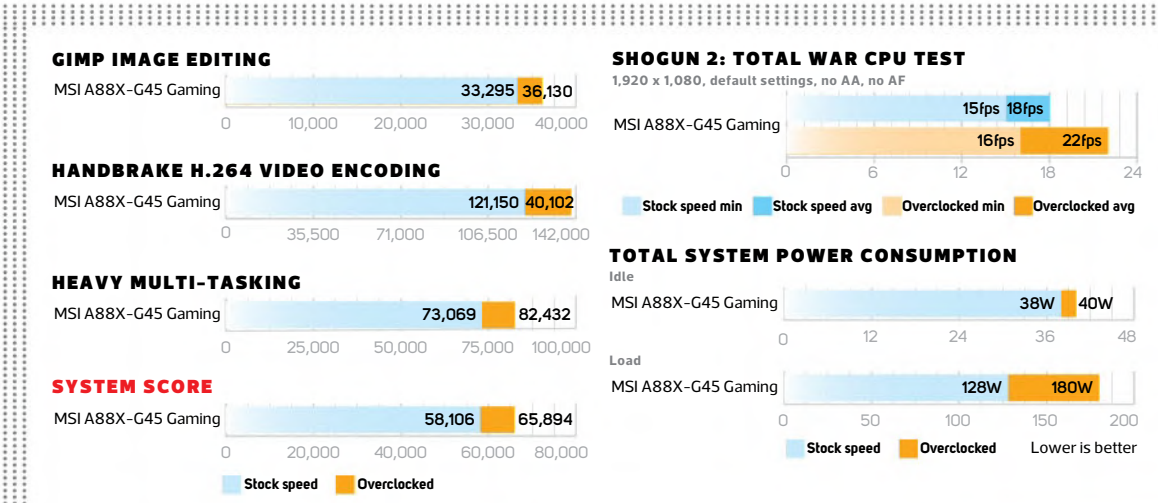
Even so, this overclock resulted in some welcome performance increases of nearly 3,000 points in the image editing test, close to 19,000 extra points in the video encoding test and nearly 9,000 points in the multi-tasking test, with the system score rising from 58,106 to 65,894. This did have the result of increasing power consumption to 180W under load, although at idle, the difference between stock and overclocked was just 2W.

Conclusion

We're still in two minds as to whether an ATX-sized Socket FM2+ motherboard is a worthwhile investment. After all, if you intend to use more than one discrete graphics card, Intel's Core i5 and i7 Devil's Canyon chips provide a much more powerful foundation and, unlike a Pentium G3258 system, you can't upgrade the CPU in an FM2+ system to one from a more powerful family later.

There's a case for using the Socket FM2+ platform as a super-cheap entry into the PC gaming market, though, and the A88X-G45 Gaming offers plenty of upgrade potential from CrossFire to discrete sound cards and even PCI-E storage using the ample on-board slots. It might have niche appeal and inflexible integrated GPU overclocking, but the A88X-G45 Gaming ticks all the other boxes.

ANTONY LEATHER



SPEED 34/40 | FEATURES 25/30

VALUE 21/30

OVERALL SCORE 80%

VERDICT

There's a small but definite niche market for large AMD Socket FM2+ motherboards, and the A88X-G45 Gaming is a well-designed board that fits this niche well.

/TEST KIT

3.9GHz AMD A10-7870K, 16GB Corsair Vengeance Pro DDR3 2,133MHz DDR3 memory, 128GB OCZ Vector 150 SSD, Corsair Pro Series Gold HX750 PSU, Windows 7 64-bit

ATX CASE

Fractal Design Define S / £70 inc VAT

SUPPLIER www.scan.co.uk

The Define S is an interesting addition to Fractal Design's line-up, as it offers much the same case as the Define R5 by way of features, looks and noise dampening. The R5 was only launched recently, and was good enough to earn a spot on our own Elite list, so you may be wondering why Fractal is replacing it so soon. The answer, simply, is that it's not being replaced – the Define S sits alongside the R5, offering an alternative internal design while staying within the highly praised Define aesthetic.

Externally, the Define S and R5 are difficult to tell apart, and have virtually identical dimensions. From the faux brushed aluminium effect on the solid, plastic front panel, to the trio of ModuVent blanking plates guarding the three roof fan mounts, to the seven white expansion slot covers, they have lots in common.

There are some differences, however, even on the outside, most notably the lack of a front door on the Define S. Previously, this door guarded the optical drive bays and fan control switch, but both of these features have been stripped from the Define S. Thankfully, the new solid front panel pulls cleanly away from the chassis and reveals a full-cover magnetic dust filter for the triple fan mounts – one more than the Define R5. Also intact are the ventilated strips down either side of the front. Two USB 2 ports have been removed from the front I/O panel too, but the two USB 3 ports remain.

> There are zero visible drive cages; just a big open space at the front

The case stands on a lovely set of rubberised feet, but the bottom dust filter, which protects both the PSU and bottom intake fan areas, now pulls out from the rear, rather than the front. Sadly, it's difficult to realign this filter without tilting the case to one side.

Meanwhile, the clear window has been extended in both height and depth, now taking up the vast majority of the left side panel. A windowless version is also available, in which case the panel has a single 140mm/120mm fan mount instead of a window, again guarded by a ModuVent blanking plate.

On the whole, build quality is good, although the steel sections impress more than the plastic ones – the front fascia and ModuVent blanking plates feel a little weak, for example. Thankfully, steel is used almost everywhere else, and the side panels in particular are very sturdy. These panels also come away easily enough to grant you access, but the clip system for the roof blanking plates can be fiddly.

However, when you look inside, you'd be forgiven for thinking the Define S had shipped incomplete, as there are zero visible drive cages of any sort – just a big open space at the front. This emptiness is entirely by design, though, and contributes to a new, clean and very spacious interior that gives you loads of room for water-cooling gear and airflow, while also making that extended window a great idea.

What you do get in the main area are the usual neat touches – a decently sized CPU area cut-out, thumbscrews for the expansion slots and foam that helps to isolate the PSU and dampen its vibrations. The motherboard tray has also been extended right to the front, in order to keep all the drives and wires behind it shielded from view.

As with the R5, there are two dedicated 2.5in drive trays behind the motherboard, which can be independently released using thumbscrews. The same system is also used for the trio of 3.5in/2.5in trays stacked behind the new front section of the motherboard tray. These trays include anti-vibration mounts for hard drives and they're dead simple to use.

The new design benefits airflow by removing all internal obstructions, although you'll still have to contend with the solid front panel. The main benefit, though, is for water-cooling systems. The Define S actually has the same radiator support as the R5 – up to 360mm or 420mm in the roof and up to 360mm or 280mm in the front (note that radiators with 140mm fans in the roof must be slimline and have only one row of fans).

The difference with the Define S is that this support comes out of the box, with no need to remove or relocate any cages. The Define S also considers reservoir and pump placement – the front of the motherboard tray has reservoir mounting holes, and brackets for tube reservoirs are

/SPECIFICATIONS

Dimensions (mm) 233 x 533 x 465 (W x D x H)
Material Steel, plastic
Available colours Black
Weight 8.5kg
Front panel Power, reset, 2 x USB 3, stereo, mic
Drive bays 3 x internal 3.5in/2.5in, 2 x internal 2.5in
Form factor(s) ATX, micro-ATX, mini-ITX
Cooling 3 x 140/120mm front fan mounts (1 x 140mm fan included), 1 x 140mm/120mm rear fan mount (140mm fan included), 3 x 140mm/120mm roof fan mounts, 1 x 140mm/120mm bottom fan mount (fans not included)
CPU cooler clearance 180mm
Maximum graphics card length 425mm
Extras Removable dust filters, ModuVent blanking plates, noise dampening material

supplied, with pump mounting points drilled out at the front of the floor too. Finally, that massive window will let you show off even more of your loop, which is especially important if you're using dyed coolant and hardline tubing.

Cable routing is excellent as well, with grommet-covered holes above, below and to the side of the motherboard. There's also ample room in the rear section, especially at the front, and the four supplied Velcro cable ties are a joy to use – there's no excuse for building a messy system.

1 **The motherboard tray has been extended right to the front**

2 **There's room for a 420mm water-cooling radiator in the roof**

3 **Cable routing is excellent, with huge, grommet-covered holes**

Performance

The Define S achieves perfectly respectable results for a low-noise case. In fact, its results are nearly identical to those of the Define R5 on full speed, which isn't especially surprising.

The only difference is a slightly improved GPU result, which is probably a result of the open, airflow-friendly interior, but it's only a 1°C difference; the main limiting factor in both cases is likely to be their mostly solid front panels.

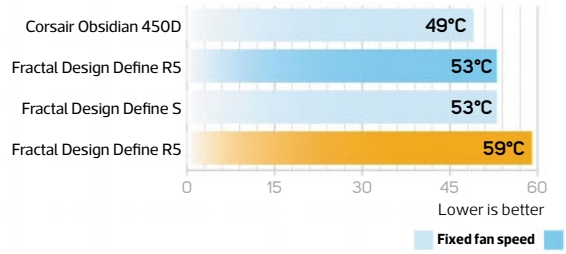
While the R5 still takes the crown for low noise (especially thanks to its fan controller), the Define S is still quieter than most cases that pass through our lab. There's always a trade-off in thermal performance in such situations, but the Define S proves itself capable of adequately a cooling a mid to high-end system with at least a moderate CPU overclock applied.

Conclusion

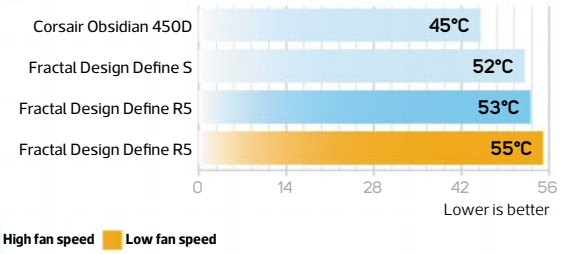
It's excellent to see manufacturers paying more attention to the needs of custom water cooling, and Fractal deserves praise for its inclusion of reservoir and pump mounting points on top of substantial radiator support. Elsewhere, the Define S impresses too – it's well equipped to keep noise to a minimum, offers the potential for an extremely tidy build and working with the case is, as ever, very simple. The Define R5 remains a good, flexible case for all-round systems, but the Define S with its clean, modernised interior and lower price tag, is a very welcome addition to the market, especially for water cooling.

MATTHEW LAMBERT

CPU LOAD DELTA T



GPU LOAD DELTA T



Fixed fan speed | High fan speed | Low fan speed

COOLING	FEATURES
19/25	22/25
DESIGN	**VALUE**
27/30	18/20

OVERALL SCORE
85%

VERDICT

An open, water-cooling friendly interior, coupled with Fractal's usual prowess elsewhere, makes this case a winner.

GAMING LAPTOP

HP Omen 15-5012na / £1,499 inc VAT

SUPPLIER www.hp.com

HP's latest Omen laptop looks distinctly different from your everyday gaming laptop. The lid and base are decorated with a sleek dotted pattern, with dramatic lines and angles, and the interior is no less striking: the speaker grilles glow with a red backlight, and the sunken keyboard is similarly illuminated. Those red lights even appear in the two exhausts on the Omen's back edge.

The cylindrical hinge has off-colour ends that start with a blue finish and fade to a neat rainbow-style effect, and the glossy screen bezel and classy logos add a touch of class. The Omen doesn't skimp on features either. The left-hand side of the keyboard has six macro keys, each of which can be modified with five different macros, so it's possible to have 30 different combinations on each profile – a boon for complex games. There are also four USB 3 ports alongside HDMI and DisplayPort connectors, plus the 15.6in panel is a touch-screen.

Build quality is great too. The screen doesn't exhibit much movement, there's barely any budge in the wrist rest and the underside is just as solid. This machine will withstand being lugged around in a bag, but we'd still use a protective sleeve to avoid damaging the smart exterior.

The good build quality is especially impressive given this machine's dimensions. It's just under 20mm thick and weighs 2.1kg, so it's thinner and lighter than other gaming laptops we've seen, such as MSI GE72's, which is 27mm thick and weighs 2.4kg, and the Gigabyte P35x V3, which was 22mm thick but weighed 2.3kg.

There are a couple of quibbles though. Every port aside from the SD slot is on the back, which makes it tricky to get at USB connectors. There's also no easy way to get inside; the screws are hidden beneath rubber strips on the base and once they're removed, there's no way to properly reattach them.

Meanwhile, the keys on the Scrabble-tile keyboard feel solid, with a rapid and consistent action that lends itself to fast gaming. There's not much travel in the keys, which may annoy those used to mechanical units, but you can't have everything on a thin and light laptop. The touchpad is also wider than the pads on most laptops, but it doesn't add much to the experience, and its pair of built-in buttons are light and clicky – as always, you'll be better off using a separate gaming mouse.

Then we come to the HP Omen app, which enables you to customise the keys, as well as the backlight, which can be altered or turned off in five different zones, and even the speaker LEDs can be modified or deactivated – potentially a boon, as they pulse in time with music. The touch-screen and several other buttons can also be turned off so they don't interfere with games, and the fans can be tweaked.

In terms of specs, there's a 2.5GHz Core i7-4710HQ sporting four cores (and four virtual cores via Hyper-Threading), and it's paired with a Maxwell-based Nvidia GeForce GTX 860M GPU.

Storage comes from a 512GB Samsung XP941 M.2 SSD, and there's 16GB of memory too. Networking connections are lacking though. There's dual-band 802.11n Wi-Fi but no sign of 802.11ac, and you have to use a provided USB adaptor to get Gigabit Ethernet access.

Performance

The Core i7-4710HQ might not be the fastest CPU available, but it's still powerful enough for most people's needs. Its four cores and Hyper-Threading support enabled it to rack up a score of 199,384 in our multi-threaded video encoding test, but its comparatively low clock speed meant it only managed 37,459 in our image editing test. The end reference score of 75.13 per cent isn't bad for a thin and light laptop, but it also shows the extra processing power you can get from a more powerful desktop chip.

In the all-important gaming tests, the GTX 860M also showed its limitations. It couldn't manage a playable frame rate in any of our test games at maximum settings at the screen's native 1080p resolution. However, taking the settings a step down to a still decent level resulted in a respectable 33fps minimum in Battlefield 4 at High Detail, and a playable 26fps minimum in Shadow of Mordor at Very High Detail, although Crysis 3 remained unplayable, with a minimum of just 16fps.

The 1,920 x 1,080 screen resolution makes sense for the level of power available from the GTX 860M, but the glossy covering doesn't help matters, especially under bright lights. Meanwhile, the screen's excellent delta E of 1.94 is hindered by the comparatively cool colour temperature of 8,326K, and the brightness level of 338cd/m^2 is good, but the black level and contrast results of 0.39cd/m^2 and 867:1 aren't quite as impressive.

/SPECIFICATIONS

CPU 2.5GHz Intel Core i7-4710HQ

Memory 16GB DDR3

Graphics Nvidia GeForce GTX 860M

Screen size 15.6in 1,920 x 1,080

Storage 512GB Samsung XP941 SSD

Weight 2.1kg

Ports 4 x USB 3, HDMI, mini-DisplayPort, SDXC card slot, 2 x audio

Dimensions (mm) 380 x 245 x 19.9 (W x D x H)

Extras Windows 8.1 64-bit

Warranty One year parts and labour, return to base

HOW WE TEST
PAGE 32

On the plus side, the Beats speakers are loud and punchy, with a good balance between treble and high-end sounds. Bass is a little weak by default, but that's easily rectified in the Beats Audio control app.

The HP Omen's thermal performance is right on the edge too – its CPU and GPU delta Ts of 68°C and 66°C respectively mean its top Celsius temperatures are both in the 90s.

The noise was never too bad, but those are definitely some toasty temperatures. As a result, we also noticed the centre of the base heating up significantly during high workloads, which is never good if you're wearing shorts.

The Omen did benefit from its more balanced design in one area though – battery life. In a gaming battery test with the screen at 100 per cent brightness, it lasted almost 90 minutes; most gaming laptops we test last under an hour.

Conclusion

HP's Omen is great-looking and well made with some cracking aesthetic features, good speakers and surprisingly long battery life. However, it also gets hot and it lacks the gaming power needed to play current games at top settings. The Omen's faults are also harder to swallow because of its comparatively high price – a cheaper version with 8GB of RAM and a 256GB SSD is available for £1,299, but it will still get hot and have similar gaming performance. Other laptops deliver similar gaming power for less cash, such as the £999 MSI GE72 with its GeForce GTX 960M. You're undoubtedly paying a premium for the build quality and aesthetic perks, which isn't necessarily bad – it definitely looks classier and more striking than many gaming laptops; it's just a shame its gaming performance can't match its dashing looks.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING

HANDBRAKE H.264 VIDEO ENCODING

LUXMARK OPENCL

HEAVY MULTITASKING

SYSTEM SCORE

INTEL REFERENCE: 75.13%

BATTLEFIELD 4

1,920 x 1,080, High Detail, 0x AA

1,920 x 1,080, Ultra Detail, 4x AA

SHADOW OF MORDOR

1,920 x 1,080, Very High Detail

1,920 x 1,080, Ultra Detail

CRYSIS 3

1,920 x 1,080, High Detail, 0x AA

1,920 x 1,080, Very High Detail, 0x AA

SPEED	DESIGN	OVERALL SCORE
18/25	23/25	82%
HARDWARE	**VALUE**	
21/25	20/25	

VERDICT

Good-looking and well built, but it's also pricey and lacks the gaming power of cheaper rivals.

GAMING MOUSE

Cougar 700M / £56 inc VAT

SUPPLIER www.overclockers.co.uk

Adjustable mice can be very hit or miss when it comes to ergonomics and comfort, but that hasn't prevented Cougar from deciding to allow its flagship gaming mouse, the 700M, to offer a modicum of adjustable surfaces. The 700M isn't as adjustable as some mice we've seen, though, such as those from MadCatz's R.A.T series. Only its palm rest can be moved, via the built-in adjustment screw, but Cougar includes an alternative rest, so whether you're small or big-palmed, or use a palm grip or claw grip, you should be able to move the palm rest up or down to roughly suit your needs.

Its palm rest can be moved by tweaking the adjustment screw

That said, the mouse is quite flat, and the wrist rest only raises from the tail edge, so it's more suited to fingertip and claw-grip users than Logitech's G402, for example. The latter is predominantly a palm-grip mouse thanks to its high arching back – a feature that's entirely absent on the 700M. It's comfortable in the other two grip styles, though, and it's also solid and well made, although a couple of the edges could be rounded off a little better.

There's a plethora of programmable buttons too – eight in total, including a sniper-mode thumb button that momentarily reduces the sensitivity so you can get an accurate headshot. There are also two standard thumb buttons, a scroll wheel button and a further small button to the side of the left mouse button. The DPI button only allows for cycling the sensitivity one way, though, rather than the up or down cycling you can do on the G402 and most of Corsair's mice.

/SPECIFICATIONS

Sensor 8,200dpi laser
Connection Wired, USB
Cable 1.8m, braided
Materials Plastic, aluminium
Extras Additional palm rest, weights

On the plus side, there's a great software package available from Cougar's website, which provides the ability to set the four dpi levels between 50 and 8,200dpi in 50dpi increments. You're also able to set the sniper button's resolution, with independent X and Y axis control for all these settings. You can also create profiles based on specific games and record macros, as well as custom key assignments to launch programs or control media.

Using the 700M is thankfully a very positive experience. The ADNS-9800 laser sensor offers a smooth movement that complements the mouse's weight and friction. It isn't a light mouse, though, weighing in at 130g, and that's without its four optional 3.5g weights that slot into a pull-out container at the top, so it's already noticeably heavier than the 108g Logitech G402. Meanwhile, the side sections sport a honeycomb inset texture to improve grip and help prevent sweaty fingers, while the palm rest and finger buttons are also slightly textured. Finally, an LED at the front of the mouse can be set to change colour based on the selected profile, although it's tricky to see in daylight.

Conclusion

The Cougar 700M offers excellent customisation software, it's relatively comfortable to use and has loads of buttons. It's also solid and well-made, although it isn't the best option for palm-grip users. Its weight makes it feel solid under your hand too, although that's a matter of personal taste. If you like a heavy mouse, though, and you prefer a claw-grip or fingertip play style, the Cougar 700M offers a customisable, well-made mouse that's a pleasure to use.

ANTONY LEATHER

DESIGN	FEATURES	VALUE
32/40	31/35	20/25

OVERALL SCORE **83%**

VERDICT

A good choice for fingertip and claw-grip users, and it includes an extensive feature set and a genuinely useful software suite.

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COMPONENTS

PERIPHERALS

SOFTWARE

OVERCLOCKING BUNDLES

MOBILE COMPUTING

COMPUTERS

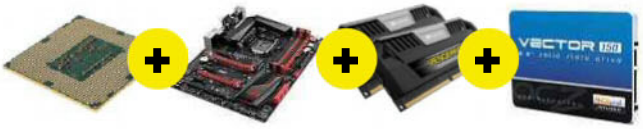
How we test

Thorough testing and research is the key to evaluating whether a product is worth buying, and deciding whether or not there's a better alternative

PROCESSORS

We judge CPUs on whether they offer sufficient speed for the price. Part of a CPU's speed score comes from how overclockable it is. Every type of CPU is tested in the same PC, so all results are directly comparable.

INTEL LGA1150



Intel LGA1150 CPU | Asus Maximus VII Ranger | 16GB Corsair Vengeance Pro 1,600MHz DDR3 | 240GB OCZ Vector 150

INTEL LGA2011-V3

Intel LGA2011-v3 CPU | Asus Rampage V Extreme | 16GB Corsair Vengeance LPX 2,133MHz DDR4 | 512GB Crucial MX100

AMD FM2+

AMD FM2+ APU | MSI A88X-G45Gaming | 16GB Corsair Vengeance Pro 2,133MHz DDR3 (GPU testing) | 8GB Corsair Vengeance Pro 1,600MHz DDR3 (CPU testing) | 240GB Crucial M500

COMMON COMPONENTS

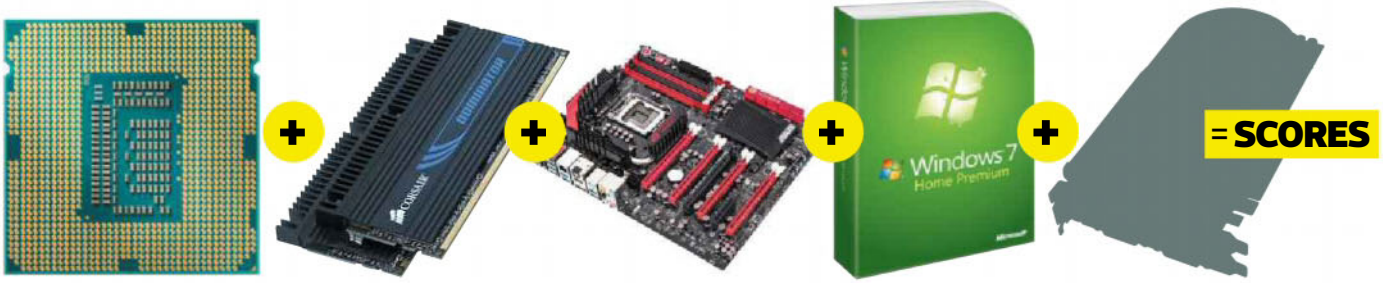
Nvidia GeForce GTX 780 3GB | Windows 7 64-bit

TESTS: We use Custom PC RealBench 2015, Cinebench R11.5 and a variety of games. We also test the power draw of the test PC with the CPU installed. These tests reveal a broad range of performance characteristics, from image editing to gaming and video encoding to 3D rendering. We run all tests at stock speed and again when overclocked to its highest frequency.

*Please note: We test AMD FM2+ APUs using the on-board graphics, not the Nvidia GeForce GTX 780 3GB

GRAPHICS CARDS

Graphics cards are mainly evaluated on how fast they are for their price. However, we also consider the efficacy and quietness of the cooler. Every graphics card is tested in the same PC, so all results are directly comparable.



4.2GHz Intel Core i5-3570K | 8GB Corsair Dominator 2,400MHz DDR3 | Asus Maximus V Extreme | Windows 7 64-bit | The graphics card we're reviewing

CUSTOM PC REALBENCH 2015

INTEL REFERENCE

Intel Core i7-4790K | 16GB of Corsair 2,400MHz DDR3 | 240GB OCZ 150 | Asus Maximus Gene VII | Nvidia GeForce GTX 780 3GB = 100%

AMD REFERENCE

AMD A10-7850K | 8GB of Corsair 2,133MHz DDR3 | 256GB Plextor M5 Pro | Asus A88X-Pro = 100%

Our benchmark suite, co-developed with Asus, simulates how people really use PCs – a higher score is better. You can download them from www.asus.com/campaign/Realbench

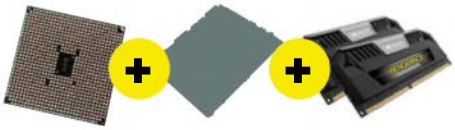
MOTHERBOARDS

Motherboards are evaluated on everything from layout and features to overclockability and value for money. Every motherboard is tested with the same components, so all results are directly comparable.

INTEL LGA1150

Intel Core i7-4790K | Motherboard on test | 16GB Corsair Vengeance Pro 1,600MHz DDR3 | 240GB OCZ Vector 150

AMD FM2+



AMD A10-7870K | Motherboard on test | 16GB Corsair Vengeance Pro 2,133MHz DDR3

INTEL LGA2011-V3

Intel Core i7-5960X | Motherboard on test | Plextor M6 256GB | 32GB Crucial 2,133MHz DDR4

COMMON COMPONENTS

Nvidia GeForce GTX 780 3GB* | Windows 7 64-bit

TESTS: We use Custom PC RealBench 2015 and several games, and also test the speeds of the board's SATA ports. We try to overclock every motherboard we review by testing for a maximum QPI, base clock or HTT as well as overclocking the CPU to its maximum air-cooled level. We run our tests at stock speed and with the CPU overclocked.

*Please note: We test AMD FM2+ motherboards using the on-board graphics, not the Nvidia GeForce GTX 780 3GB

TESTS: By using the fast PC detailed on the left, we can be sure that any limitations are due to the graphics card on test, rather than being CPU limited. We test the four games (above) at their maximum detail settings, in their highest DirectX mode, at several resolutions. High-end cards should be able to sustain playable frame rates at 2,560 x 1,440, while 1,920 x 1,080 is more important for mid-range cards; we also test at 3,840 x 2,160 for 4K monitors, and try to overclock every graphics card we test to assess the performance impact.

The Awards

EXTREME ULTRA
Some products are gloriously over the top. These items of excellent overkill earn our Extreme Ultra award.

PREMIUM GRADE
Premium Grade products are utterly desirable – we'd eat nothing but beans until we could afford them.

PROFESSIONAL
Products worthy of the Professional award make you and your business appear even more awesome.

APPROVED
Approved products are those that do a great job for the money; they're the canny purchase for a great PC.

CUSTOM KIT
For those gadgets and gizmos that really impress us, or that we can't live without, there's the Custom Kit award.

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Custom Kit

Paul Goodhead checks out the latest gadgets, gizmos and geek toys

BLUETOOTH SPEAKERS

Antec Wav and Antec Wedge / £36 & £17 inc VAT

Despite being better known for cases and PSUs, Antec has been carving out a niche in the mobile accessories market of late. The Wav and Wedge Bluetooth speakers are its latest gambits, which enter a market more crowded than a casting session for Game of Thrones extras.

First up is the Wedge that, not surprisingly, is wedge shaped. However, this natty design allows the speaker to double as a phone stand thanks to the four suckers situated on its long edge. It works too; the suckers clung to every device we had to hand, even a textured phone case, and the speaker is small, smart and unobtrusive when not being used as a stand. Unfortunately, while its size makes it discreet, it also limits it as a speaker. The audio is tinny and underwhelming, while the side-facing drivers mean that they fling the sound away from you, rather than at you.

The Wav, on the other hand, feels more serious. It's larger and more expensive, with solid build quality to match, and you get much more in the way of features, including on-speaker controls, NFC pairing and hands-free calling. Audio is reasonable, with solid treble and bass reproduction, as well as enough volume to fill a room. It's let down by flimsy mid-tones that lack clarity and punch, though, leaving audio lacking in heart and warmth. Still, the sound isn't bad, and you get some decent features for the money too.

WAV ●●●○○
WEDGE ●●○○○
SUPPLIER www.amazon.co.uk

USB3 HUB

Icy Box IB-AC619 / £19 inc VAT

The AC619 is basically a USB 3 hub with some audio I/O connectors, which you might think would handily bring your audio connections and some USB 3 ports from the rear of your case to a handy location on your desk. But it's heavily let down by a short cable; if you're using it with a tower PC, the hub just dangles from the port into which it's plugged. Maybe it's designed for use with laptops, but in that case, why add the audio ports, which you usually find on the side or front of laptops anyway?

If the cable were longer (for example, 1.5m) then the hub would offer a tidy way to bring the USB 3 ports hidden at the back of your PC up onto your desk, while also turning one port into three. In its current state, however, it's a potentially handy device that's let down by an obvious flaw.

●●○○○

SUPPLIER www.scan.co.uk

CAMERA

HTC Re / £129 inc VAT

The peculiar-looking HTC Re is billed as a lifestyle camera, and its periscope shape raised eyebrows wherever we took it. Notwithstanding the odd aesthetics, it works rather well as a point-and-click device; the pistol grip feels surprisingly natural in your hand, and the big button on the nape of the neck makes it easy to shoot video and photos quickly. You can pair it with a smartphone or tablet too, allowing for a live-view mode if you find the lack of a viewfinder annoying, or to enable control of the device from a distance.

Unfortunately, the Re's image quality isn't great; its results are certainly below the quality offered by a decent smartphone, for example. Chromatic aberration was common and low-light performance was poor, with the image often suffering from excess noise. Still, it's fun to use and much more convenient to lug around than a DSLR..

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SUPPLIER www.htc.com

USB DRIVE

Kingston DataTraveler 4000 16GB / £40 inc VAT

Costing £40 for 16GB of storage, the DataTraveler 4000 is a bit like the Fort Knox of USB sticks. Armed with hardware-based FIPS 140-2 (Level 2) encryption, enforced complex password creation, a read-only access mode (for malware protection) and tamper-evident seals, the contents of the DataTraveler 4000 are safe from prying eyes. It's even titanium-coated and waterproof to 4ft, while ten wrong attempts at the password will securely wipe the contents of the drive. It's hardly quick though – this USB 2 drive registered sedate read and write speeds of 66.3MB/sec and 11.4MB/sec respectively, meaning it would take nearly 25 minutes to fill its 14.9GB formatted capacity. Still, if security is your prime concern, the DataTraveler has you well covered.

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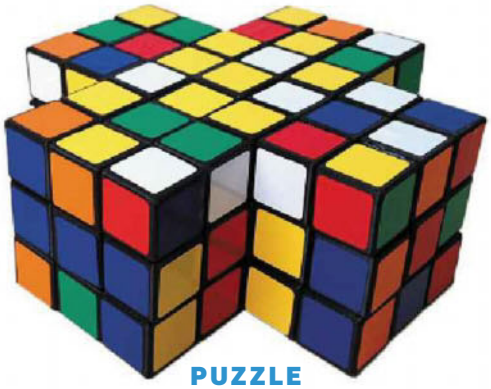
SUPPLIER www.ebuyer.com



PUZZLE

The X Cube / £25 inc VAT

Crowdfunded via Kickstarter and seemingly built for puzzle masochists, the X Cube is a fiendishly difficult variant of the iconic Rubik's Cube. Built in a distinctive X shape (hence the name), the puzzle has a mind-boggling 125 decillion variations (that's 33 zeroes); not surprisingly, that was more than enough to vex us. We can at least attest to the X cube's build quality – it stood up to us tossing it aside in disgust on numerous occasions. For the weak-willed puzzlers there's at least a plan B – all the coloured blocks are built to simply snap off the central rotation mechanism, making for an easy way of resetting (or, as we're tempted to call it, solving) the puzzle.

●●●●○

SUPPLIER www.firebox.com

Seen something worthy of appearing in Custom Kit? Send your suggestions to paul_goodhead@dennis.co.uk

LABS TEST

Open case

We put 12 premium chassis, with a value up to £150, through their paces, to find the best homes for your components

Although your computer's case doesn't contain much in the way of digital technology, it's still a complicated part. Its purpose may seem simple, but there are countless small details in a case that affect both how your PC fits together and what can be put inside it. Dreams of a heavily overclocked, water-cooled PC are quickly shattered when you find you can't fit a radiator in the right place, or a drive bay gets in the way of that long, powerful graphics card you just bought.

And a PC's chassis can directly affect performance too. If you overclock your PC, reaching the highest speeds often depends greatly on how efficiently your PC's chassis and its fans can keep internal temperatures at a safe level, particularly if you're relying more on air cooling than water cooling. Airflow is affected by many factors, from the layout of internal components to the types of fan used.

Plus there are fundamental aspects to consider, such as build quality, looks and size. There's plenty to think about, and an overwhelming amount of choice. This month, we've reviewed 12 premium cases, with a value up to £150; however, as you'll see over the next few pages, there's still considerable variation between cases models even within this relatively narrow bracket.

MATTHEW LAMBERT AND ORESTIS BASTOUNIS

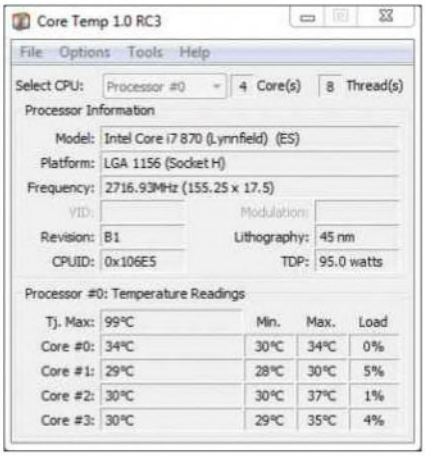
Featured this issue

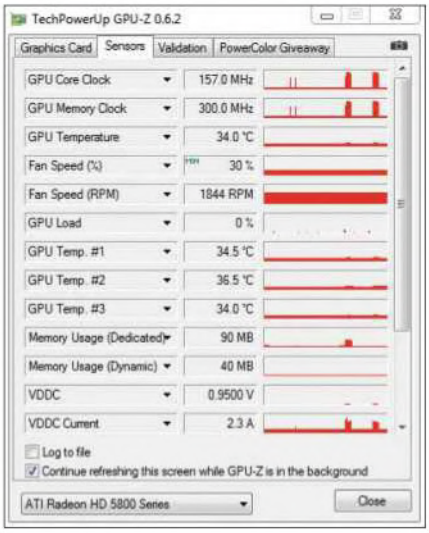
How we test

All cases are tested using our standard ATX test kit, which includes a Biostar TPower I55 motherboard, an Intel Core i7-870 CPU and 4GB (2 x 2GB) of OCZ 1,866MHz DDDR3 RAM. While this setup isn't exactly modern nowadays, it produces a relatively high and constant amount of heat with which the chassis has to deal. Accordingly, we overclock the CPU from 2.93GHz to 3.41GHz using a base clock of 155MHz and a 22x multiplier. The vcore is locked at 1.305V and the CPU PLL set to 1.9V. We also disable any power-saving features to ensure that the frequency, and thus the heat output, is as consistent as possible.

The CPU is cooled by a Gelid Tranquillo fitted with a Noctua NF-S12B ULN 120mm fan, which we run at a fixed speed via a direct connection to one of the PSU's 12V Molex plugs. The use of a modest cooler and a slow-spinning, low-airflow fan places more of a burden than a fast-spinning fan on the case when it comes to dealing with the CPU's heat. Our overclock may not be massive, but with the limited CPU cooling in some cases, it's enough to ensure that our CPU reaches 80°C or even 90°C under load.

To see how well a case can cope with heat from the GPU, we use an ATI Radeon HD 5870 1GB at stock speed. The card is a reference design, and uses a blower-style cooler where all heat is exhausted directly out of the rear of the card. This system ensures that minimal hot air re-enters the chassis, and thus tests how well a case can feed your graphics hardware with cool air. We use the Catalyst Control Center to disable automatic fan control and lock the fan at 30 per cent speed to prevent it from interfering with the results. The remaining components in our test kit are a Corsair Force GT 60GB SSD and an Antec Signature SG-650 PSU.





We record the CPU temperature with Core Temp, and the GPU temperature with GPU-Z, then subtract the room temperature from these figures

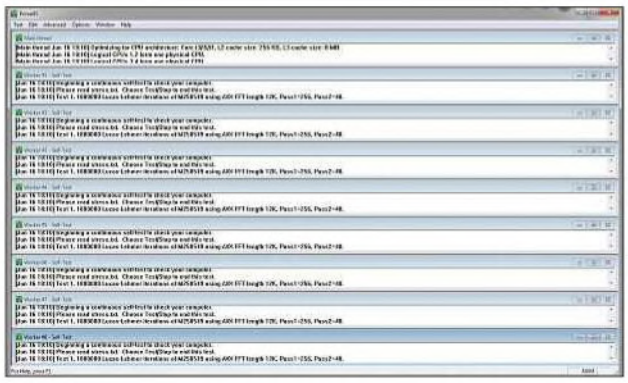
We begin by building a full system, so we can determine how easy a case is to work with and the quality of its design. With cases in this price bracket, we also look for expandability in terms of water cooling, which is a likely use for large, high-end builds. With the system built, we also tidy away cables as best as the case allows, so there's minimal interference with airflow.

> We look for expandability in terms of water cooling

Just as the CPU and GPU fans are run at constant speeds throughout testing, so too are the default fans supplied with a chassis. Like the CPU fan, these fans are connected directly to a 12V Molex plug, which runs all fans at full speed.

If there's a fan controller, we hook up all case fans to it (not the CPU fan) and test at the maximum and minimum speeds. Finally, if a case has a removable hard drive cage that potentially affects airflow, we test both with it installed and removed.

We run Prime95's smallfft test to stress all CPU cores to 100 per cent load and, at the same time, the Unigine Heaven benchmark running at 1080p with default settings, in order to place full load on the GPU cores. After 15 minutes, which is enough time for temperatures to plateau, we note the maximum CPU core temperature as recorded by CoreTemp, and the maximum GPU temperature as reported by GPU-Z. Finally, we measure the ambient room temperature, and calculate the difference between this figure and the recorded values to produce a delta T result.



Once we've installed our test rig in each case, we run Prime95's smallfft test to stress test the CPU, and Unigine Heaven to run the GPU at full pelt

Be Quiet! Silent Base 800 / £88 inc VAT

SUPPLIER www.cclonline.com

Be Quiet! might be a veteran manufacturer of power supplies and cooling hardware, but the Silent Base 800 is, so far, its only foray into the PC chassis business. It's designed for low noise first and foremost, and has a slightly lower price point than the rest of the cases in this Labs. It comes in either all-black, or with a trim that adds a flashy silver or orange tint.

It takes its name from the stand, which is included for extra stability and grip thanks to its rubber base. However, it isn't fixed to the chassis and can be removed completely if you want to save space.

At the front of the case, three optical drive covers sit behind a door that clips firmly shut with a strong magnet. This door is coated in a noise-dampening foam-like nylon substance and occupies the upper section of the front. Below this part, the lower section opens outwards, revealing a pair of 140mm fans, with a dust cover in front of them.

The I/O ports are located at the top, including pairs of USB 2 and USB 3 ports, and audio connectors right next to a large square power button. A glaring omission in this place, though, is a fan controller, which is particularly puzzling given the focus on quiet computing.

Along with the two intake fans, a 120mm exhaust fan is included, with space for two more 120-140mm fans in the roof, a 120mm fan at the side, and another at the bottom.

Two removable 3.5in drive cages are located on the right-hand side, one of which holds up to three drives, with the other holding four. There's a set of holes for 2.5in drives on the top of each caddy too, with space for another two 2.5in drives behind the motherboard tray; your only place for storage if both cages are removed.

There are some good cable management options provided too, with grommets covering the four holes in the motherboard tray that match the trim colour of the case. A hole has also been placed in the top of the tray for the EPS12V connector and the fan cables.

Although the Silent Base 800 is a tad larger than most mid-sized cases, water-cooling support is limited to just a slimline 240mm or 280mm radiator in the top. No more than a 120mm radiator will fit in the rear, or more than a 140mm radiator in the front, which would also necessitate removing both drive cages. Even then it's a bit of a squeeze.

But again, this chassis hasn't been designed to be the last word in water cooling, but for quiet air cooling. Noise-dampening measures are applied to the drive bays via rubber rails, the PSU area has rubber feet and padding, and the fans all have rubber grommets to keep vibrations away from the chassis. It doesn't quite go to the same obsessive lengths to reduce noise as Nanoxia on its Deep Silence 5, but it works well.

Plus, although its cooling isn't the greatest we've ever seen, its CPU and GPU delta T of 55°C is still cooler than the NZXT H440 by a couple of degrees, and the Silent Base 800 is considerably less expensive.

Conclusion

The Silent Base 800 doesn't offer as many features or the same cooling efficiency as some of the pricier cases in this Labs, but it holds up well in its own niche, achieving better thermal results than some larger cases with more fans, while operating at low noise and costing a reasonable price.

If getting low-noise computing without sacrificing air-cooling ability is your top priority, and you have a tight budget, this is a fine case. **OB**

COOLING	FEATURES	OVERALL SCORE
21/25	21/25	84%
DESIGN	**VALUE**	
24/30	18/20	

VERDICT

Not as feature-rich as some of its competitors, but it successfully offers low-noise computing without killing airflow, and it's reasonably priced too.

ELITE
NEW ENTRY
P62

Cooler Master Cosmos SE / £125 inc VAT

SUPPLIER www.cclonline.com

Eagle-eyed readers will immediately spot that the Cosmos SE is a mid-sized version of Cooler Master's venerable Cosmos series of chassis. It uses the same signature rigid metal bars running along the top and bottom, both for ease of transport and to act as a sturdy stand, aided by rubber feet. It packs a considerable amount of features into a mid-sized chassis too, with plenty of space for internal storage and fans, plus brackets for radiators.

It's also easy to disassemble. The front mesh filter clips off easily, which then allows the front bottom filter to slide out as well. Removing a thumbscrew at the rear allows the inner roof section to slide out, which uses a mesh and fibre polymer filter, which is now a popular inclusion on many PC cases.

Your PSU is installed in a bracket before you slide it into place, where it rests on thick rubber stands, with a filter that's once again easy to remove.

Meanwhile, the left-hand case panel is flat with a large window, while the other is extruded, providing space for cable management. The right side panel is extremely rigid and sturdy, but the window makes the other panel not quite as sturdy. This case caters well for cable management too, with plenty of holes placed around the inside for tucking cables out of the way, most of which have rubber grommets, although space for threading cables between the motherboard and hard disk cages is a little tight. The motherboard tray also has a large cutout for CPU-cooler backplates.

In terms of cooling, there are two 120mm intake fans, a 120mm rear exhaust fan and another 140mm exhaust fan in the roof. With four fans and a liberal use of mesh filters, the Cosmos SE offers excellent airflow. Fans can also be mounted externally, with a hole provided for sliding the power connectors through to the inside. There's plenty of room for water-cooling gear too. There's space for two radiators, with included mounting brackets for either a 240mm or 280mm radiator at the top and a 360/280/240mm radiator at the front.

There's loads of storage options as well. The three plastic optical drive covers at the front are easy to remove, and there are eight internal bays, each of which has a removable plastic tray than can support either a single 3.5in hard disk or two 2.5in drives, or you can even install additional fans in them. Although this setup almost sounds like overkill, internal space is slightly limited; with a long graphics card, you'll need to remove one of the hard disk cages, which come out in pairs, and you'll need to remove more for multi-GPU setups.

While this sounds like a limitation, a mid-sized case isn't usually a first choice for a multi-GPU water-cooled setup anyway, and the sheer volume of bays, plus their flexibility, means there's still plenty of space for internal storage, even if one cage is removed. This limit also explains the need for an additional pair of 2.5in bays behind the optical drive cage, in the event of removing all four drive cages. We certainly had to remove one while testing the Cosmos SE, as our test graphics card didn't quite fit.

In terms of airflow, the Cosmos SE wasn't quite as cool as the SilverStone Fortress FT05, but its CPU and GPU delta Ts of 53°C and 49°C respectively are still excellent for a mid-sized case.

Conclusion

The Cosmos SE offers great out-of-the-box cooling, plenty of extra features and flexibility, and it also has loads of room for water-cooling gear, not to mention sporting a nifty design and appearance. A great all-round enthusiast case. **OB**

COOLING	FEATURES	OVERALL SCORE
23/25	23/25	87%
DESIGN	**VALUE**	
26/30	15/20	

VERDICT

Great cooling, plenty of features and flexibility, plus a great design and appearance, make the Cosmos SE a great mid-sized case for enthusiasts.

NZXT H440 SE / £125 inc VAT

SUPPLIER www.overclockers.co.uk

The special edition of NZXT's H440 has been designed in collaboration with Razer, adding some features and eye candy to what was already a nifty PC chassis, in exchange for some extra outlay.

Aesthetically, while the H440 is traditionally a minimalistic design, this special edition has small nods to Razer's styling throughout the design, with bright green USB connectors and a lighting kit that highlights both the rear and underside of the case, but not so much that it becomes piercingly bright. The Razer logo at the front is similarly illuminated, once again in a tasteful manner. The entire design is swish and the branded improvements and lighting kit are nice additions to what was already a very attractive case.

The H440 SE's design isn't just about great looks though; plenty of thought has gone into the internal design too. A PSU cover (once again, with a bright green Razer logo) not only keeps all the cables out of view, with a generous amount of space to house excess cabling, but it also serves to keep the area around the motherboard clear from clutter.

Even with minimal effort, it really isn't hard to build a clean, tidy, good-looking PC with the H440 SE. Along with the PSU cover, there's a large number of holes around the motherboard tray for cable routing, plus all the cables for the LEDs and fans are already connected and neatly routed out of the way, straight out of the box.

There's also a hub for up to ten 4-pin Molex connectors located just behind the motherboard tray. It can handle a power load of up to 30W, which is enough for a full complement of 120mm fans, or even a water-cooling pump and radiator fans. Its main purpose, though, is cable management, again removing the need to clutter space around the motherboard with fan cables.

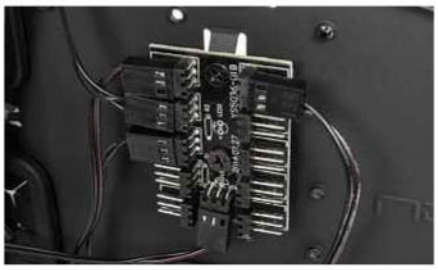
All six storage bays are individually removable, supporting either 2.5in or 3.5in drives, with two further dedicated 2.5in mounts on top of the PSU cover. This array of drive mounts provides quite a lot of flexibility if you need to make room in the case for other parts. It's worth noting, however, that there's no support for optical drives, although we don't consider this omission a major issue these days, considering the affordability of external drives if you need one.

Three front-mounted 120mm fans at the front are included, and can be swapped out for a pair of 140mm fans, with space for radiators in the roof and front. There aren't any vents on the case exterior, though, which could affect overall thermal efficiency. Meanwhile, if you want to install water-cooling gear, there's natural room for a triple 120mm radiator at the front, or a double 140mm model, with support for full-height model too.

Identical fittings are found in the roof, although no fans are included out of the box. While you should still be able to squeeze a second radiator in the roof, though, you're limited to half-height models, since the motherboard slightly gets in the way.

Finally, there's a 140mm exhaust fan included at the back.

In our thermal tests, the H440 SE pushed out slightly higher delta T temperatures than the best airflow cases, with both the CPU and GPU delta T results hitting 57°C, possibly due to the lack of venting at the front, and



thermal performance is really the H440 SE's only weakness. These results are still cool enough to cope with an overclocked PC, though, and they're not as important if you're going to be water-cooling your PC anyway; plus, the H440 SE was quiet during our tests.

Conclusion

While the H440 SE doesn't offer the best airflow, the great-looking design, well-considered features, flexibility and water-cooling support make it an excellent all-round mid-sized enthusiast chassis. **OB**

COOLING	FEATURES	OVERALL SCORE
19/25	24/25	86%
DESIGN	**VALUE**	
28/30	15/20	

VERDICT

Its airflow isn't the best on test, but the H440 SE's great design, flexibility and water-cooling support make it a superb all-round chassis.

SilverStone Fortress FT05 / £131 inc VAT

SUPPLIER www.scan.co.uk

SilverStone's mid-sized Fortress case range is traditionally focused on excellent build quality and superb cooling performance. It's a tradition that continues with the FT05, which is a touch smaller than the older and slightly pricier FT04, but it still undoubtedly shines in both these areas.

Aluminium has been generously used throughout the design, with a sharp, clean finish and thick, rigid case walls that offer a level of quality above many other firms' efforts. The rubber feet give a noticeably better grip than we're used to seeing too, and there's a neat reflective trim around the bottom of the case with a great-looking power LED that shines through it with the SilverStone logo.

As with many SilverStone chassis, the interior is rotated, with expansion cards mounted vertically and air intake at the bottom from a pair of 180mm fans, with air pushed out the top. A thick layer of foam dampens noise in a cutout section below the fans at the bottom, with a magnetic filter that clips to the inside. Magnetic filters are also provided for both the dual 180mm intake fans and the rear section near the PSU.

Moving to the top, the I/O section has the usual pair of USB 3 ports, plus audio jacks and fan control, with a great-looking mesh that fits in with the aluminium appearance of the case. It's disappointing that this mesh is made from painted plastic instead of the same aluminium used in the rest of the design though.

On the downside, assembly can be tricky, especially since the PSU is vertically mounted, making it a challenge to secure in place with the case standing vertically. If your PSU is longer than 160mm then you'll need to remove the plastic 3.5in drive cage too. What's more, with no other 3.5in bays available, and only a pair of 2.5in bays behind the motherboard tray, internal storage options are rather limited, being comparable to a mini-ITX case. On the plus side, there's at least space for a slot-loading slimline optical drive to be mounted behind the motherboard tray.

Meanwhile, a rear cutout allows I/O cables to be routed neatly out of the back, but there isn't a lot of support for cable management inside. Cable ties are supplied, along with bridges on the motherboard tray. There are also plenty of cutout holes along the motherboard tray with grommets. However, cable-routing space is at a premium, and the situation isn't helped by the thick layer of sound-absorbing foam; you'll need to spend some extra time routing wires and cables if you want a clean PC build.

There's also limited space for water-cooling gear – you can get away with installing a 280 or 360mm radiator at the bottom and the top exhaust fan mount will support a 120mm all-in-one liquid cooler, but anything more complicated will again require you to remove the drive cage. This case is really designed for air cooling, though, and in this respect, it excels, with a lower CPU and GPU delta E than the other three mid-sized cases in this Labs.

Conclusion

The FT05 is an attractive, well-built chassis that's great for air cooling, and the aluminium adds a premium feel to its design. Ultimately, however, you aren't getting a huge amount for your money.

The internal space is slightly limiting both for storage and cable management, and there isn't much room for a larger PSU or water-cooling gear either. If both air-cooling ability and build quality are your priorities, then this is the case to buy, but you can get a better balance of enthusiast features elsewhere. **OB**

COOLING	FEATURES	OVERALL SCORE
23/25	16/25	78%
DESIGN	**VALUE**	
26/30	13/20	

VERDICT

Well built and fantastic for air cooling, but there's limited room inside for drives, cable management and water-cooling gear.

PC Specialist recommends Windows 8.1

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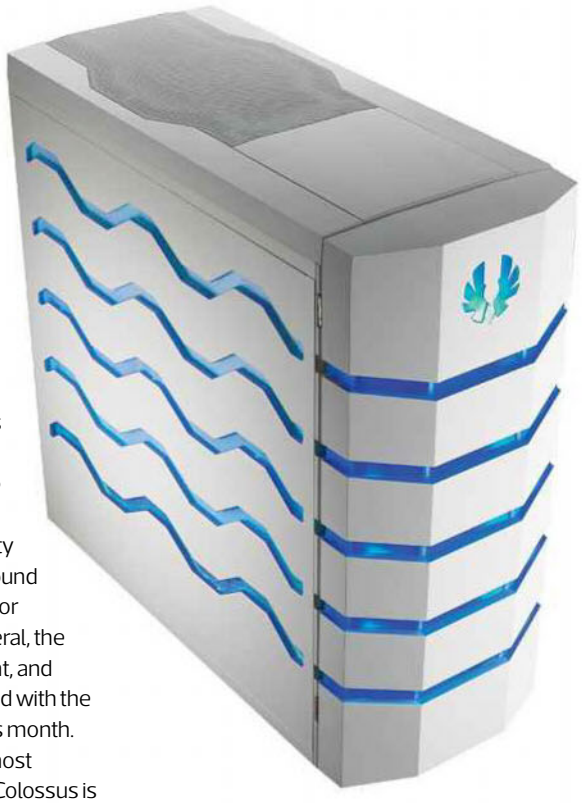
SUPPLIER www.overclockers.co.uk



The Colossus is one of the oldest cases we've covered in this Labs test, first going on sale in 2010. Although that's a long time in the fast-paced world of PC tech, the Colossus remains a viable option as a giant case that supports E-ATX motherboards. It's still also the largest case in BitFenix's line-up, which is otherwise geared more towards smaller micro-ATX and mini-ITX case designs.

The most striking feature of the Colossus is its S3 lighting system, which wraps around the sides, and can be switched between red or blue colours. Multiple LEDs shine through a transparent film to create the effect, which looks great and will make your PC stand out at a LAN event, or in any darkened room for that matter. The lighting controls are housed in a control panel at the top, with a pop-up hatch. Alongside these controls are pairs of USB 2 and USB 3 ports, the usual audio connectors, an eSATA port and a rotary fan control dial.

In a few areas, the Colossus is showing its age though. It's hard to imagine anyone needing five 5.25in drive bays these days, for example. Meanwhile, its seven tool-free internal storage bays are stacked on top of one another, and have been designed to either hold 2.5in or 3.5in drives. These drive bays aren't great, though, as they're made from flimsy plastic – you'll have to be careful not to apply too much pressure to them. Comparatively, most other modern cases in this price bracket have much stronger drive bay mounts.

Conversely, though, the provision for cable management is notably forward-thinking, with plenty of space running behind the motherboard. The front cables are pre-routed too, and there are plenty of holes positioned around the motherboard tray for excess cabling. In general, the build quality is excellent, and holds up well compared with the other cases on test this month.

Perhaps the other most obvious aspect of the Colossus is its sheer size. To match it, BitFenix has included a pair of enormous 230mm fans, one at the front acting as an intake fan, and another exhaust fan in the roof. There are two more mounts at the rear and on the floor, both suitable for 140mm fans, which aren't included in the box. Meanwhile, the fan headers are already connected to the fan controller, with space for an additional four headers, and the rest of the I/O cabling comes pre-routed by BitFenix.

While all this airflow sounds good in theory, though, the solid door at the front leaves little room for air intake. As such, despite the massive fans, the cooling ability of the BitFenix Colossus were among the worst on test, with the GPU delta T hitting 58°C and the CPU delta T reaching 59°C (and even going up to 68°C on the slowest fan speed). By comparison, that's almost 10°C warmer than the best performer in this size class, Thermaltake's V71.

Unlike NZXT's H440 SE, for example, the Colossus doesn't make up for these warm results with a superb feature set and extensive water-cooling support either. A double-height radiator will fit in the roof with some clearance to spare, but fitting a second radiator in the front will involve needing to remove most of the drive bays, or even to mod the case, depending on the radiator used.

Conclusion

The Colossus doesn't offer the very best cooling efficiency, the most modern design or even the best value for money. It still holds up reasonably well in some areas, though, and it has a striking appearance too. If you want a case that's big, bright and looks badass, and you're not running a heavily overclocked rig, then the Colossus fits the bill, but otherwise, you can now get better cooling, flexibility and design for similar money elsewhere. **OB**

COOLING	FEATURES	OVERALL SCORE
17/25	18/25	68%
DESIGN	**VALUE**	
20/30	13/20	

VERDICT

Distinctive looks and good cable management, but you can now buy a case with superior cooling, more flexibility and a superior design for the same price elsewhere.

Corsair Graphite 760T / £140 inc VAT

SUPPLIER www.awd-it.co.uk

Corsair's Graphite range usually features a bolder design than its Obsidian cases, but with the 760T, Corsair has gone with one of its most radical designs yet. Rather than a side window, one of the panels is made from an entirely translucent polycarbonate material, subtly tinted for a great view of the interior.

There's another neat touch to both the side panels – they swing open on hinges, after just unhooking them with large handles, without needing to undo any thumbscrews. They're straightforward to put back into place, and can be removed completely if you want, since they're not fixed to the hinges. When they're closed, the handles then secure them flush against the side of the case.

At the front, a piece of mesh and a dust filter at the bottom sits in front of a pair of 140mm white LED fans, with three optical bay covers in the top section, and another 140mm exhaust fan at the back. In addition, there are three 120mm fan mounts in the roof, or alternatively, you can put another pair of 140mm fans there. A plastic magnetic dust cover protects these mounts, although it's a bit flimsy compared with the quality of the rest of the components in this case.

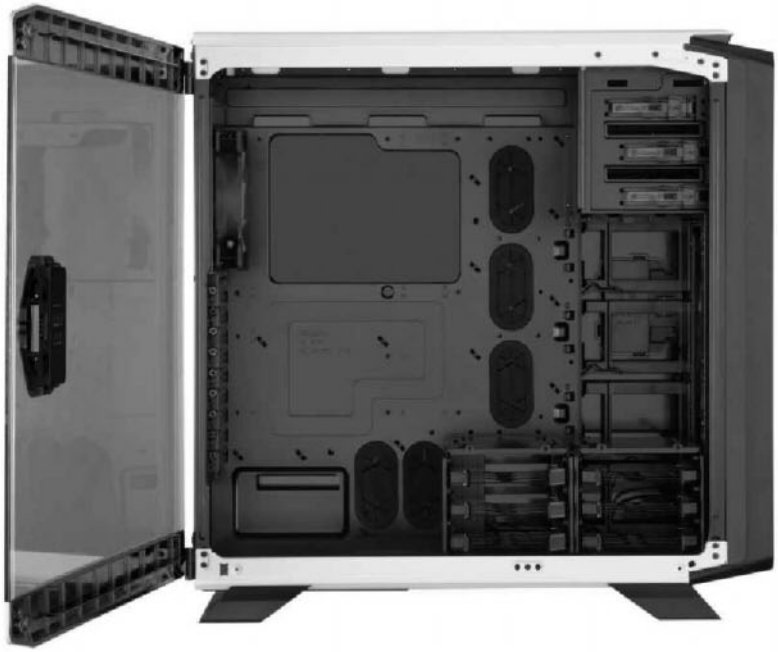
The 760T is also an exceptionally large chassis, measuring 568mm high and 564mm deep. As such, it can accommodate motherboard sizes all the way up to XL-ATX, with nine expansion slots in total. There's up to 460mm of space for graphics cards, and there's 180ms of CPU cooler clearance too.

It also leaves plenty of space for water-cooling kit, with full-height radiators comfortably fitting in the roof (up to a triple 120mm or double 140mm) and by removing one of the front drive cages you'll be able to squeeze a second radiator of the same size into place.

Both drive cages are easily removable, and each contains well-designed plastic bays that can house both 3.5in and 2.5in drives, which can be fitted without needing any tools. Behind the motherboard tray you'll also find four more 2.5in bays for SSDs, providing some extra capacity to fit internal storage even if both drive cages are removed.

Meanwhile, at the top, you get the standard array of I/O ports, with pairs of USB 2 and USB 3 ports, audio jacks, a dual-speed fan controller and buttons for power and reset. There's also evidence of some effort to dampen the sound output, with strong rubber feet both underneath the case and mounted underneath the PSU.

There are a few more goodies too, with yet more examples of Corsair's attention to detail. The case caters very well for cable management, with five large holes on the motherboard tray, each protected by black rubber grommets. The motherboard cutout is particularly large as well, and there's lots of space behind the right-hand panel to stash cables and connectors.



The interior is entirely painted black, which is a sensible choice, given that the tinted side panel will mean it's always on display. And there are even black sleeves around all the internal cables, so they won't become an eyesore, which is another neat touch.

The Graphite 760T delivers reasonable cooling ability too, with a CPU and GPU delta T of 54°C at maximum fan speed, and the GPU delta T dropping to 50°C with a front hard drive cage removed. However, we found it to be a little on the noisy side, even with the fans on low speed – a slight weakness in an otherwise strong line-up.

Conclusion

The Graphite 760T is a great-looking case, with efficient cooling and great attention to detail, although it's also comparatively noisy. Stiff competition means it only narrowly misses out on an award, but it's still a great all-rounder if you prefer its looks to the award-winning cases on test. **OB**

COOLING	FEATURES	OVERALL SCORE
21/25	21/25	84%
DESIGN	**VALUE**	
27/30	15/20	

VERDICT

Combines a sleek, attractive appearance with decent cooling and great attention to detail, making it a solid all-rounder, although it's also a little noisy.

Corsair Obsidian 750D Airflow Edition / £140 inc VAT

SUPPLIER www.scan.co.uk

If you really want to make sure you have enough space for a PC build that's kitted out with all the trimmings, your best bet is to put it all in a truly massive case. Measuring 546mm deep and 560mm high, Corsair's Obsidian 750D isn't the largest case we've reviewed, but it's still on the massive side. Its cavernous internal space has also been designed to maximise flexibility, and will let you comfortably fit an XL-ATX motherboard, multiple GPUs up to 450mm in length and a tower-based cooler up to 170mm, plus there are nine expansion slot brackets.

Sporting a minimalist all-black look (hey, it's an Obsidian chassis), its lack of visual appeal may split opinion, though, and its only distinctive feature is its large side window. It's fairly wide too, measuring 235mm across, using stretched 5.25in bay covers; the top one hosts the front I/O panel, sporting a pair of USB 2 and USB 3 ports, along with audio connectors, plus a power and reset button.

Also at the front are two powerful 140mm intake fans, which deliver cool air to the case interior, with a 140mm exhaust fan included as well.

This Airflow Edition of the chassis also features a perforated mesh on the front, rather than a solid panel, in order to maximise the amount of air going into the two intake fans. At the top, you'll also find mounts for two more 140mm fans (or three 120mm fans) and there's space for two more 120mm fans at the bottom too.

A full-height water-cooling radiator (a maximum width of either triple 120mm or dual 140mm) can fit in the roof, with the bottom storage mounts giving way to space for a second radiator at the bottom. You can also remove the front fan mounts and pop a radiator at the front too if you want. Without modding the case, you can basically fit dual and triple-fan radiators at the same time, a feat that not every modern case can manage.

The Obsidian 750D caters well for cable management too, with plenty of space for excess wiring behind the motherboard tray, along with easy access to the storage section. Five large holes in the motherboard backplate are protected with rubber grommets and there are plenty of hooks to feed cable ties through. Meanwhile, the large CPU cutout will make it life easier when you're changing your CPU cooler.

Meanwhile, the six internal drive bays are suitable for either 3.5in or 2.5in drives, with a further four sideways-mounted 2.5in bays positioned on the far side from the motherboard, fixed in place with tool-free clips. The drive bays are housed in two cages, holding three drives each, which sit on the bottom, right next to the PSU.

Our thermal tests resulted in a GPU delta T of 50°C and a CPU delta T of 51°C, results that exactly match a few of the other large-sized cases, such as Fractal Design's Define XL R2. They're good results for an out-of-the-box fan configuration. Sadly there's no fan controller, but thankfully the 750D's fans don't make too much noise anyway.

Conclusion

Although it isn't the most exciting-looking PC chassis, little has been left out from the design of the Obsidian 750D Airflow Edition. It sports flexible storage caddies, good cable management, plenty of internal space and great water-cooling support, not to mention decent cooling from its default fan configuration, which earns it a well-deserved thumbs up, despite it being a little on the pricey side. **OB**

COOLING	FEATURES	OVERALL SCORE
22/25	20/25	85%
DESIGN	**VALUE**	
28/30	15/20	

VERDICT

It might not win any beauty contests, but the Obsidian 750D AE offers everything you need from a big chassis, including good water-cooling support, flexible storage caddies and loads of space.

Fractal Design Define XL R2 / £100 inc VAT

SUPPLIER www.ebuyer.com

The Fractal Design Define XL R2 is surprisingly affordable for such a large case, with support for XL-ATX motherboards and graphics cards up to 480mm in length. It sports Fractal's trademark minimalist looks, and a few noise-dampening additions, with foam applied liberally throughout the case. Fans of Fractal cases will also recognise the I/O panel, with a large central power button, audio connectors, and pairs of USB 3 and USB 2 ports. A triple-speed fan controller is also included, but it's strangely not integrated into this panel.

Meanwhile, the optical bays are protected by plastic covers, which are easily removed with a small clip. They're hidden behind a flat door at the front, which is covered in padded foam for sound suppression, and this door closes firmly shut with a magnetic grip. You can also lift off this entire section with a simple tug.

In the lower front section is a removable caddy with two mounts for either 120mm or 140mm fans, requiring either clips or screws to hold them in place.

One 140mm fan is included in this section, although it seems a little mean of Fractal Design to not offer the second as well. More 120mm/140mm fan mounts are found in the roof and on the main side panel, with a 140mm exhaust fan included at the rear. Other than this fan mount, the side panels are nothing more than sheets of steel, though, without any other discernible features.

There are two removable drive cages, each of which holds four 2.5in or 3.5in drives in white drive bays. A considerable amount of flexibility is offered when positioning these cages too. The top one can be rotated 90 degrees, or you can move it closer to the PSU, freeing up a chunk of space inside the case.

More rubber and foam anti-noise material is found inside, with the PSU sitting on stands, and noise-dampening sections sitting below the fan guards in the roof.

There are two removable dust filters too – one at the bottom and one protecting the front fan caddy.

There's also space for water-cooling setups, with 120mm radiators fitting snugly in the lower fan mount and space for a 140mm radiator at the rear. By removing the drive cage, you can also get a 240mm radiator into the front, while 240mm or 280mm radiators will fit in the top without any problems. It's a tad disappointing that you can't take advantage of the large space to fit a triple-fan radiator on the roof, though, as you can with the smaller Define S (see p26).

Meanwhile, the XL R2 caters well for cable management, with four massive routing holes, and a few smaller ones too, all of which are lined with flexible grommets, although the position of the holes assumes you'll only be using an ATX motherboard. Zip ties and hooks are provided too, with plenty of free space behind the motherboard tray for excess cabling and wires.

In terms of thermal efficiency, with its out-of-the-box fans, the Fractal Design Define XL R2 sits roughly in the middle of the larger cases we've tested, with a GPU delta T of 50°C, and a CPU delta T of 51°C. These results are fine, especially considering the door on the front of the case. It's quiet too, although it isn't quite the same example of tranquil, quiet computing as the Nanoxia Deep Silence 5.

Conclusion

The Define XL R2 is cool, quiet and affordable but, disappointingly, this full-sized chassis doesn't offer much of an advantage over Fractal's excellent mid-sized cases. If you're looking for a quiet, full-sized case, the Nanoxia Deep Silence 5 is a better bet, while Fractal's cheaper Define R5 or S cases are ideal if you're looking for a quiet case on a tight budget. **OB**

COOLING	FEATURES	OVERALL SCORE
22/25	20/25	84%
DESIGN	**VALUE**	
24/30	18/20	

VERDICT

Cool, quiet and affordable, but it's a shame you can't take full advantage of all the extra space.

ELITE NEW ENTRY P62

Nanoxia Deep Silence 5 / £115 inc VAT

SUPPLIER www.quietpc.com

Some cases are designed for ultimate cooling efficiency, some for swanky looks and others for flexibility. As its name may suggest, though, the Nanoxia Deep Silence 5 is intended for minimal noise output.

It gets off to a great start by being very well built. It's definitely on the heavy side, but it's also very sturdy. Noise-dampening materials are everywhere, occasionally at the expense of alternative design choices that may have otherwise bolstered cooling efficiency. Thick foam lines both the hefty side panels and the roof of the case, in addition to the two doors at the front, covering the dual 140mm intake fans and optical bays. This setup works against the cooling system, though, blocking some of the air coming into the case, which will affect temperatures. There are also two fan mounts at the top with blanking plates on them to keep sound in and dust out. Meanwhile, the PSU rests on rubber stands in order to keep vibrations to a minimum, and it's isolated from the rest of the case with foam around the edges.

The Deep Silence 5 is also enormous. Measuring 550m deep and 550mm tall, it's up there with the largest cases in this Labs test, and therefore comfortably supports E-ATX and XL-ATX motherboards in addition to the usual motherboard sizes. Right below the 140mm fan mount, there are ten expansion slots in total, giving the flexibility to cram a huge number of devices into the case. Even with a quad-GPU setup, you'll still have space for more backplates.

These large physical dimensions don't necessarily mean the best possible water-cooling support, though. A slimline 240mm or 280mm radiator will fit in the roof, while a 240mm radiator of any thickness will go in the front. It can cover the basics, but there are better cases available for large water-cooling gear.

On the plus side, there's support for plenty of internal storage. Up to eleven 2.5in or 3.5in drives can be squeezed into metal drive trays in one of three hard disk cages. One cage holds five drives, there's space for another three in a second cage, while a third cage further back in the case holds another three. You can remove the front two cages to add a radiator and still keep storage in the third cage, and there's also an adaptor to convert one of the 5.25in bays into a 3.5in bay.

Nanoxia has also put a lot of effort into cable routing, with well-designed rubber grommets covering the holes, which fit like a glove. The external water-cooling holes are similarly protected with grommets. Clips at the back of the motherboard tray are a bit on the scarce side though. There's also a bundled pair of extension cables for your PSU's 24-pin ATX and 8-pin CPU connectors, in case they don't reach. These are small additions that may go unused by many, but it shows Nanoxia's attention to detail for PC builders.

As predicted, the additional noise-dampening materials result in the Deep Silence 5 hitting the mid-ground in cooling efficiency, but it still performs surprisingly well in terms of cooling. Given the number of extra features it offers, good looks and silent operation, it's a superb design.

Conclusion

The Deep Silence 5 is extremely well designed, and big enough to house a huge number of components. It has plenty of features, good cooling ability and it's also one of the more affordable cases in this Labs test.

Most importantly, though, it achieves its aim of being near-silent in use, making this case the one to buy if low-noise computing is your top priority. **OB**

COOLING	FEATURES	OVERALL SCORE
20/25	24/25	88%
DESIGN	VALUE	
27/30	17/20	

VERDICT

The huge Deep Silence 5 offers near-silent operation, loads of well-considered features, a great design and reasonable cooling ability. A superb case if low noise is a priority.

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NZXT Phantom 630 Windowed Edition / £130 inc VAT

SUPPLIER www.overclockers.co.uk

The Phantom 630 Windowed Edition (a slightly modified update to the older Phantom 630) has some dominating dimensions, measuring 600m deep and 627mm tall. It's even wider than most of the other cases on test, measuring 245mm across, giving you 200mm of CPU cooler clearance for even massive tower coolers.

The extra width presents great cable management options too, with plenty of space behind the motherboard for extra wires. Large rectangular holes cut into the motherboard tray provide ample opportunity to thread your cables behind the motherboard try, and they're protected by well-fitting rubber grommets. However, some of the fitting is still a little tight, and an extension cable for the 8-pin power cable would have been welcome, as ours was just slightly short.

The case comes in a range of colours, including white, black and gunmetal grey. The design also has rounded edges and exceptionally solid build quality, even though it's made from the same steel and plastic as other cases on test. On the top, the I/O ports are positioned on the left, separated from the power and reset buttons on the right. There's also a three-speed fan controller and a button to trigger LEDs that illuminate the rear I/O panel, which is a neat touch. There's an SD card reader too, which is becoming a rarity these days.

As with Corsair's Graphite 760T, the side panels are mounted on hinges, and they're fully removable by undoing thumbscrews. However, when you're replacing the panels, the fit isn't as flush as it is on the Graphite 760T, and they need a strong push to fit them back into place.

An angled window occupies most of the space on the left side panel, replacing the small window and 200mm fan mount on the non-WE variant of the Phantom 630. There's still plenty of airflow, though, with a 200mm fan at the front, and another one in the roof, along with a 140mm exhaust fan. There are also two easily removable dust filters to protect both the lower fan mounts and the PSU, with 200mm filters covering all the upper fan mounts.

The 200mm fans can be replaced with 140mm or 120mm fans if you want, and there's space for a few more fans at the bottom, with another fan mount to cool the internal hard disk cages. The hard disk cages use truly awful drive-mounting trays though. They're flimsy and don't lock into place properly, so you'll need to secure them in place with a screw – a situation you don't expect from a premium case. On the plus side, there are four more 2.5in bays for SSDs behind the motherboard.

The test results show that the Phantom 630 WE's airflow system, with its pair of 200mm intake fans, are extremely efficient at cooling, with the second lowest GPU delta T of all the full-sized cases on test with the hard drive cage removed. Its CPU delta T of 52°C (or 51°C with the drive cage removed) is also a good result. In addition, it's also quiet, particularly at low fan speed where its cooling performance is still reasonable.

The case caters well for water-cooling gear as well, with enough space for a full-sized triple radiator in the roof. By removing the drive cages, you can also fit a second triple radiator at the front too, which is good to see.

Conclusion

Although a few question marks hang over some elements of the Phantom 630 Windowed Edition's design, such as the flimsy drive-mounting trays, this massive case is still highly efficient at cooling, and also offers plenty of flexibility and excellent water-cooling support. **OB**

COOLING	FEATURES	OVERALL SCORE
22/25	24/25	84%
DESIGN	**VALUE**	
23/30	15/20	

VERDICT

Loads of room, excellent water-cooling support and decent cooling, but NZXT needs to pay some attention to the flimsy drive bays.

ELITE
NEW ENTRY
P62

Phanteks Enthoo Luxe / £118 inc VAT

SUPPLIER www.cclonline.com

Cases with built-in lighting kits are nothing new, and a few other cases in this Labs test have them, but Phanteks has gone to extra effort in this area. The Enthoo Luxe's LEDs can be switched between ten different colours, while the case's split-window design and a cleverly planned interior that hides the ugly PSU and hard drive cages.

The Enthoo Luxe has a main window made from a large sheet of Perspex, with a second smaller trapezoid window in the lower right, leaving just the motherboard and components on display, showcasing all the cool kit in your PC but hiding the boring bits. The lights are controlled via a simple button at the front. A long press turns them on or off, while a quick press cycles through the colours. The effect is a pleasant soft glow, rather than harsh brightness, and it looks great.

Meanwhile, the chassis' insides are well built and solid, with an aluminium and steel construction. The roof and front panels are plastic, but with aluminium sheets for additional strength. The roof also has a section of mesh that can easily be clipped in or out, although it doesn't sit flush against the case.

There are numerous examples of excellent craftsmanship. The two drive bay cages contain well-designed plastic trays that feel really solid. Each bay supports 2.5in and 3.5in drives, with a pair of mounting arms to lock 3.5in drives in place, coupled with anti-vibration rubber. Both cages are removable, without having to undo thumbscrews, with small tabs to help pull them out. There are a few other similarly neat touches too, such as a rest for the motherboard while you're screwing it into place, and there's no sign of sharp or protruding bits of metal on the inside. There's also a PSU shield, which is easily removed by undoing three thumbscrews, offering a great way to hide excess cabling from view. In terms of cooling, a 200mm front intake fan sits behind an aluminium front panel, with a pair of 140mm exhaust fans at the rear. One of these fans is also height-adjustable to perfectly align it with your CPU cooler, ensuring you get the absolute best thermal efficiency. There are more fan mounts at the bottom, and a pair of 120mm mounts next to the internal hard disk cage too. As with many current cases, Phanteks has also included a PWM fan hub, which is fitted behind the motherboard tray. It sports six fan headers to help keep cabling away from the motherboard, which is very useful. Every one of the included cables is pre-routed and hidden away too, and tied down with Velcro straps.

The Luxe even caters well for water cooling, with room for a 420mm radiator in the roof, and 240mm radiators in the front and bottom mounts, as long as you remove the drive cages. In fact, if you fit a radiator to the bottom, you'll still be able to use the upper drive cage.

On top of all these extras, the Enthoo Luxe offers decent airflow, with both the CPU and GPU delta T results hovering around 50°C. They aren't the very best results on test, but they're still highly competitive.

If there's one criticism, it's that the fan noise levels are average – it's not intrusively loud, but it isn't quiet either, even on low fan speeds.

Conclusion

The Phanteks Enthoo Luxe makes cable management really straightforward, and the illumination features look great too.

However, the Enthoo Luxe isn't just about good looks and easy building – it combines all of the above with decent out-of-the-box cooling ability, a wide range of features, great water-cooling support and several sensibly considered touches, making it the best all-round enthusiast case in this Labs test. **OB**

COOLING	FEATURES	OVERALL SCORE
22/25	23/25	89%
DESIGN	**VALUE**	
27/30	17/20	

VERDICT

Loads of features, brilliant lighting effects and excellent attention to detail, not to mention decent water-cooling support, make the Enthoo Luxe the best all-round enthusiast case on test.

Thermaltake Core V71 / £124 inc VAT

SUPPLIER www.amazon.co.uk

The first design feature you notice when you get Thermaltake's V71 chassis out of the box is the all-mesh material that completely covers the top and front of the case, including the optical drive covers.

Annoyingly, the front panel is difficult to remove without first lifting up the case slightly to get a strong grip, but it then comes off with a gentle tug, revealing a pair of huge 200mm intake fans, kitted out with blue LEDs, and a removable dust filter is attached to the front to prevent those fans becoming too clogged up.

There are two more dust filters at the top and bottom, so the whole case has some anti-dust protection. These filters are easier to remove than the one at front as well – you simply slide them out at the back. Another 200mm fan sits in the roof to exhaust hot air, bringing the total to three, along with a 140mm exhaust fan at the rear. That's quite a lot of airflow right out of the box.

One of the sides has a large window, which almost takes up the entire panel, with the other side jutting out slightly further (as on many other cases) to provide room for cables and wires to be stuffed behind it. There's reasonable support for cable management too, with grommets attached to all the internal holes, although we'd have liked to have seen a few more holes, or at least bigger ones, around the case.

Take a quick peek through the aforementioned window and you'll see the stack of drive cages for internal storage, coloured blue to match the front fans. One of these cages holds two removable drive bays, while the other two cages hold three bays each for a total of eight internal bays, each supporting either 3.5in or 2.5in drives. Removing them requires undoing a plastic clip, then sliding them out.

The overall build quality feels reasonable, being solid and robust enough for everyday use. But it's not outstanding, with some odd design decisions that make the case slightly fiddly to use. For example, each drive cage has six thumbscrews to unscrew before it can be removed, which seems unnecessary, and the front panel is difficult to remove without first lifting up the case slightly to get a strong grip.

There are a few interesting inclusions too, such as the supplied extension cable for 8-pin EPS connectors, and there's also an adjustable bar at the bottom to secure the PSU into place, which can be moved to suit the length of your PSU, although it can be fiddly to adjust and isn't really necessary. Meanwhile, the I/O, power and reset buttons are located in the roof, with a fan controller that allows for high and low fan speed – that's a good inclusion, but several other cases on test offer a greater degree of fan control. There's also an on/off control for the fan LEDs, and the 200mm fans and controllers are handily all powered by a single Molex connector.

Water-cooling support is pretty good too, with space for a 420mm or 360mm radiator at the top, and another one at the front if you're happy to remove the drive cages. If you don't want to remove the drive cages, you can just about fit a slimline radiator at the front, although squeezing the tubing around them might then be a little tricky. However, the Phanteks Enthoo Luxe offers even more in the way of water-cooling support

In our thermal tests, the number of large fans in the V71 really paid off too, resulting in the lowest CPU and GPU delta T results we measured from the larger cases.

Conclusion

While there are a few design shortcomings with the V71, its out-of-the-box cooling ability really is good, with large fans pumping plenty of air through the case. However, it's up against some seriously stiff competition in this price bracket, and you can get a superior feature set and design for similar money elsewhere. **OB**

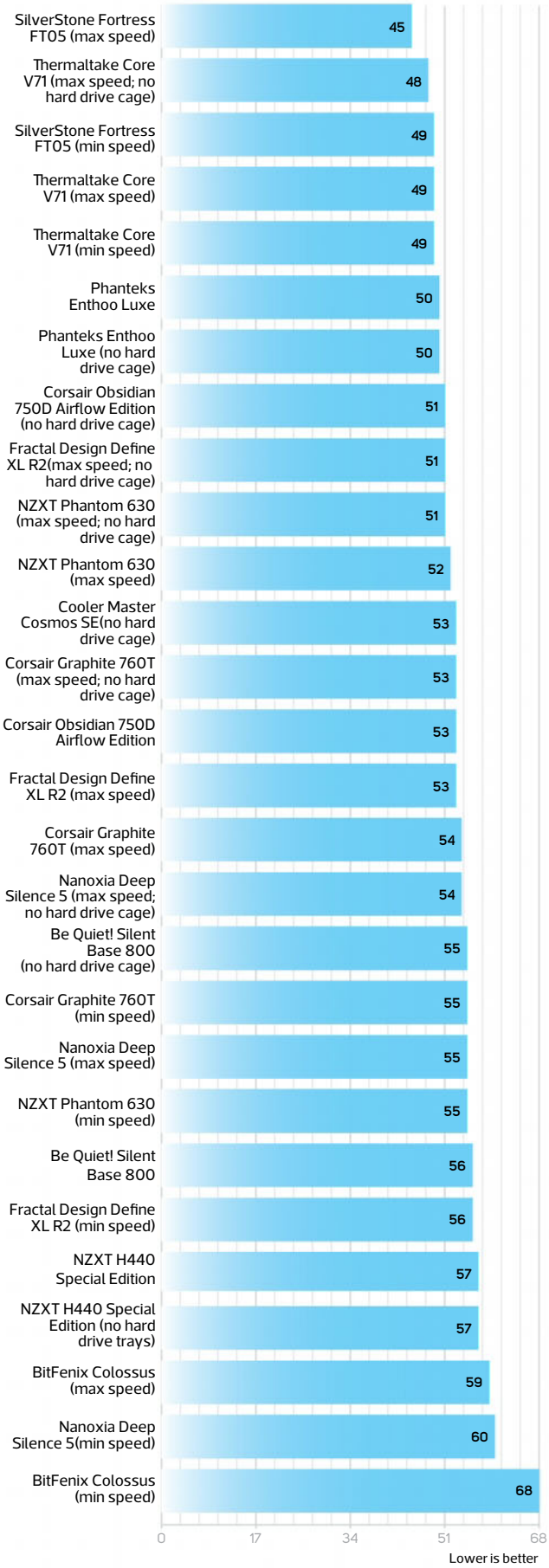
COOLING	FEATURES	OVERALL SCORE
24/25	20/25	81%
DESIGN	**VALUE**	
22/30	15/20	

VERDICT

Fantastic airflow from the large fans, but you can get a superior feature set and design for similar money elsewhere.

CPU DELTA T (°C)

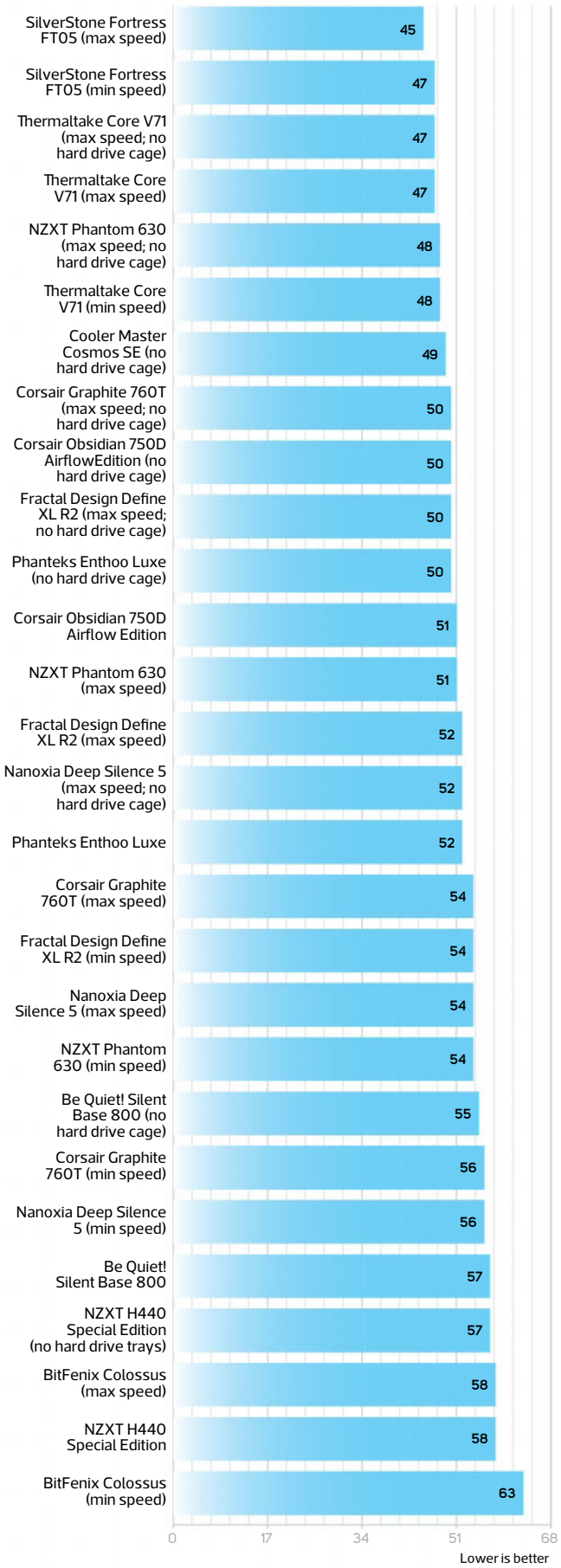
CPU temperature minus ambient temperature



Lower is better

GPU DELTA T (°C)

GPU temperature minus ambient temperature



Lower is better

PC system reviews

MINI-ITX GAMING PC

Chillblast Fusion Wolf / £1,599 inc VAT

SUPPLIER www.chillblast.com

Chillblast's new mini-ITX machine is named the Fusion Wolf, and it's an apt title – this machine is dark and brooding, with a definite bite in our benchmarks. The star of the show is Nvidia's new GeForce GTX 980 Ti. It's the reference model, so there's no overclocking, but it has enough power of its own, with 2,816 stream processors, a 1GHz core and 6GB of memory.

Meanwhile, the Core i7-4790K XPU is overclocked to 4.4GHz, and the rest of the specification is similarly beefy, with 16GB of DDR3 memory, a 256GB Samsung SM951 M.2 SSD and a 2TB hard disk. The Chillblast also shares much of its specification with the PC Specialist Nemesis Evo (see p58), which also has a GTX 980 Ti and the same Core i7 processor, although it's overclocked to 4.7GHz.

It's a close-run competition, especially as both those machines cost £1,599 and both use the mini-ITX form factor. Chillblast has deployed the Asus Z97I-Plus motherboard, which doesn't have the enthusiast features of the Republic of Gamers board in the PC Specialist system, but it's still a well-specified PCB, with dual-band 802.11ac wireless support and an M.2 port. You don't get the RoG board's POST display on the rear I/O panel, or SupremeFX audio gear, but it's a solid motherboard.

Chillblast's case differs more dramatically though. The Phanteks Enthoo Evolv is a great chassis, with plenty of room in it, but it's also comparatively large and standard-looking for a mini-ITX case. Even so, the Chillblast's interior is still a little cramped when compared with a standard ATX rig. The Corsair H80i cooling unit and its two 120mm fans hang over most of the processor socket, so CPU access will involving removing the radiator. Meanwhile, the graphics card stretches for most of the length of the case, with barely any room between its 70mm fan and the metal shroud that covers the PSU and storage bays.

Building a mini-ITX PC always involves a little compromise, though, and the Chillblast smartly gets around the lack of space in other areas. The M.2 SSD is installed on the back of the motherboard, below the CPU socket, and the two 3.5in hard disk bays can be accessed from the rear of the machine, with one lying empty. There's a spare 2.5in bay around the back too, and two more on top of the shroud around the front. It's consistently tidy too; even around the back, cables are lashed down and tied in straight lines.

Finally, Chillblast's warranty lasts for five years, including two years of collect-and-return service that covers both parts and labour, while you only get a year of collect and return parts coverage with the PC Specialist machine.

/SPECIFICATIONS

CPU 4GHz Intel Core i7-4790K overclocked to 4.4GHz

Motherboard Asus Z97I-Plus

Memory 16GB 1,600MHz Crucial DDR3

Graphics Nvidia GeForce GTX 980 Ti 6GB

Storage 256GB Samsung SM951 SSD; 2TB Seagate hard disk

Case Phanteks Enthoo Evolve Mini-ITX

Cooling CPU: Corsair H80i with 2 x 120mm fans, roof: 1 x 120mm fan; front: 1 x 200mm fan; GPU: 1 x 70mm fan

PSU Corsair CX750 750W

Ports Front: 2 x USB 3, 2 x audio; rear: 4 x USB 3, 4 x USB 2, 1 x PS/2, 1 x Gigabit Ethernet, 1 x optical S/PDIF, 3 x audio

Operating system Windows 8.1 64-bit

Warranty Two years parts and labour collect and return, plus a further three years labour-only return to base

Performance

Not surprisingly, the GTX 980 Ti scythed through our 2,560 x 1,440 benchmarks, even hitting a minimum of 46fps in Crysis 3, and it's powerful at 4K too.

Its Battlefield 4 minimum frame rate of 27fps at 4K is just about playable, and its 41fps minimum in Shadow of Mordor is solid too.

Usually, Nvidia's GeForce GTX 980 Ti can sustain a borderline playable frame rate at 4K in Crysis 3 too, although the Chillblast and PC Specialist mini-ITX machines' frame rates were slightly below the 25fps we consider playable – nevertheless, a little tweaking in the graphics options should still get you a smooth result.

The PC Specialist machine's overclock made itself felt in our RealBench 2015 benchmarks though. The Chillblast's image editing score of 62,595 was only slightly behind the PC Specialist, and the Chillblast fell behind with a result of 265,939 in our Handbrake video encoding test, compared with the PC Specialist's 273,892, thanks to its better overclock.

The Chillblast scored 124,224 points overall, which is almost 9 per cent better than our reference machine. Benchmark gremlins mean we don't have a direct comparison with the PC Specialist, but the Chillblast is

1 **A Corsair H80i liquid cooler keeps the 4.4GHz CPU under control**

2 **The case's neat PSU shroud keeps the PSU cables hidden, for a tidy interior**

3 **The GeForce GTX 980 Ti provides oodles of single-GPU gaming power**

clearly a very quick machine that won't balk at most computing and gaming tasks.

The Chillblast's M.2 SSD helped it to beat the PC Specialist in storage benchmarks too. Its sequential read and write speeds of 772MB/sec and 684MB/sec are comfortably better than the SATA drive inside the Nemesis, although the latter drive has the benefit of offering twice as much storage space.

There was little difference between the two mini-ITX machines in thermal benchmarks, with both only just keeping on top of temperatures with their tight confines. The Chillblast's top processor delta T of 67°C was only a couple of degrees cooler than that of the PC Specialist, while the top graphics delta T of 59°C was exactly the same. Thankfully, the Chillblast also keeps fan noise to a reasonable level, and neither the CPU or GPU throttled, but it does get hot during intensive workloads.

Conclusion

Chillblast's latest machine shares its graphics card and processor with the PC Specialist Nemesis Evo, so differences between the two machines come down to tiny margins. Despite its lower overclock, the Chillblast is still fast in games, its SSD is significantly faster than the one in the PC Specialist, and it has an extra year of collect and return parts coverage too. However, the PC Specialist's overclock makes it a tad quicker in application tests, and it has a better-featured motherboard, twice as much storage space and a case that's easy to carry too.

The PC you buy depends on your priorities, of course, and both machines are well built and fast, with carefully chosen components. If a fast SSD, and an extra year of collect and return parts coverage is more important to you than a higher overclock and more storage space then buy the Chillblast, but for most enthusiasts, the PC Specialist Nemesis Evo is a slightly better all-round system.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING

HANDBRAKE H.264 VIDEO ENCODING

LUXMARK OPENCL

HEAVY MULTITASKING

SYSTEM SCORE

INTEL REFERENCE: 108.54%

BATTLEFIELD 4

2,560 x 1,440, Ultra Detail, 4x AA

3,840 x 2,160, Ultra Detail, 0x AA

SHADOW OF MORDOR

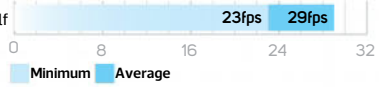
2,560 x 1,440, Ultra Detail

3,840 x 2,160, Very High Detail

CRYSIS 3

2,560 x 1,440, Very High Detail, 0x AA

3,840 x 2,160, Very High Detail, 0x AA



Minimum Average

SPEED	DESIGN	OVERALL SCORE
22/25	22/25	85%
HARDWARE	VALUE	
20/25	21/25	

VERDICT

Fast and well-built, and with a generous warranty, although for most enthusiasts, the PC Specialist Nemesis Evo is a slightly better all-round rig.

MINI ITX GAMING PC

PC Specialist Nemesis Evo / £1,599 inc VAT

SUPPLIER www.pcspecialist.co.uk

PC Specialist's latest desktop has a specification we'd expect to see in a full-sized tower system, but it's built inside the Corsair Graphite 380T – one of the most striking-looking mini-ITX cases on the market.

The Wakefield firm has deployed the white version for the Nemesis Evo, which has a white plastic frame filled in by dark side panels and a black front I/O panel. It also has a black handle at the top, which makes it easy to lug to LAN parties, and dark feet at the bottom to aid airflow.

Both side panels can be removed by unclipping levers at the top of their angled plastic surfaces, revealing the busy interior. One side is dominated by the Nvidia GeForce GTX 980 Ti graphics card, which is almost as long as the entire case, and the other is filled with the Corsair H60 all-in-one liquid-cooler and a second 120mm fan. Cooling isn't confined to the side-mounted Corsair H60 either; there's a 120mm fan at the back and a 200mm unit in the front too.

Meanwhile, the motherboard sits on a tray between the GPU and cooling gear, with the power supply and storage bays beneath it. It's a cramped interior, but PC Specialist has built the system well – spare cables are crammed beneath the motherboard tray, and the wires that do break cover are tied down neatly.

However, the mini-ITX form factor means there isn't much room to grow. The motherboard has no spare expansion or memory slots, so the only space for expansion comes from two empty SATA 6Gbps connectors, two empty 2.5in drive bays and an M.2 socket. The Nemesis Evo's specification means upgrades won't be on the radar any time soon though. The GeForce GTX 980 Ti card is a reference model, but it's still a potent part with 2,816 stream processors.

There's plenty of CPU power too. The Core i7-4790K has been overclocked from 4GHz to 4.7GHz, and it's complemented by 16GB of 1,600MHz DDR3 memory. There's plenty of storage space too, with a 500GB Samsung 850 Evo SSD, and a huge 4TB Western Digital Caviar Black hard drive.

There's an ace motherboard too. The Asus Maximus VII Impact has plenty of features for its size, including SupremeFX audio circuitry on a daughterboard below the rear I/O, and the back panel has a tiny card that holds a two-figure LED POST display, a BIOS Flashback button and a clear-CMOS switch. There's support for dual-band 802.11ac Wi-Fi as well.

There are plenty of parallels between the PC Specialist and Chillblast's Fusion Wolf (see p56). That machine also has a GTX 980 Ti, an overclocked Core i7-4790K and 16GB of memory. Chillblast's machine has an SSD that's smaller and faster, and a slightly better CPU cooler, but the PC Specialist has a higher CPU overclock, more storage space (from both the SSD and hard drive) and a superior motherboard.

The Chillblast has a more generous warranty though. The PC Specialist Nemesis' collect-and-return deal covers parts and labour for a year, with an extra two years of return-to-base labour coverage afterwards, but the Chillblast warranty extends the all-important parts coverage by an extra year.

/SPECIFICATIONS

CPU 4GHz Intel Core i7-4790K overclocked to 4.7GHz

Motherboard Asus Maximus VII Impact

Memory 16GB 1,600MHz Kingston HyperX Fury DDR3

Graphics Nvidia GeForce GTX 980 Ti 6GB

Storage 500GB Samsung 850 Evo SSD; 4TB Western Digital Caviar Black hard disk

Case Corsair Graphite 380T

Cooling CPU: Corsair H60 with 1 x 120mm fan; side: 1 x 120mm fan; rear: 1 x 120mm fan; front: 1 x 200mm; GPU: 1 x 70mm fan

PSU Corsair CS750 750W

Ports Front: 2 x USB 3, 2 x audio; Rear: 4 x USB 3, 4 x USB 2, 1 x Gigabit Ethernet, 1 x optical S/PDIF, 1 x PS/2, 3 x audio

Operating system Windows 8.164-bit

Warranty One year parts and labour collect and return, plus a further two years labour-only return to base

Performance

Not surprisingly, the GeForce GTX 980 Ti was no slouch in games. At 2,560 x 1,440, its slowest minimum frame rate was 45fps in Crysis 3, which is still a superb result. It continued to perform well at 4K too. Its Battlefield 4 minimum of 26fps was just about playable, and it sauntered through Shadow of Mordor with a minimum of 39fps. The Nemesis Evo's toughest 4K test came in Crysis 3, where it returned a minimum frame rate of 22fps. That isn't entirely smooth, but it won't take much tweaking to improve the frame rate. We've seen slightly better from GeForce GTX 980 Ti machines in Crysis 3 at 4K, but there's no doubt this is a fast gaming rig.

1 It's a cramped interior, but it's built well, with cables carefully tidied out the way

2 A 500GB Samsung 850 Evo SSD and a 4TB Western Digital hard drive are included

3 The Nvidia GeForce GTX 980 Ti graphics card is almost as long as the entire case

Meanwhile, the CPU overclock enabled it to hit an image editing score of 64,522, sneaking ahead of the Chillblast's 62,595, and the PC Specialist continued to perform well in our video encoding and multi-tasking tests – its scores of 273,892 and 157,368 were also a few thousand points faster than the scores from the Chillblast Fusion Wolf, which is only overclocked to 4.4GHz.

Sadly, we don't have an overall score for this system because our OpenCL test hit a bug and refused to run, but our other tests demonstrate the power available in this machine – and its slight lead over the Chillblast.

However, the Chillblast has the upper hand when it comes to raw storage speed. The Samsung 850 Evo SSD hit sequential read and write speeds of 511MB/sec and 449MB/sec respectively, which are decent results. The Chillblast's M.2 SSD is quicker, but most users are unlikely to notice the difference, and the PC Specialist's extra solid state storage space is arguably more useful.

Thankfully, the PC Specialist never made much noise during our stress tests, with only a small increase in noise at full load. That's good, but the cramped case has an undoubted impact on heat. The processor's delta T of 70°C is only a few of degrees short of its thermal limits, and the GPU's result of 59°C is a little high too. We never experienced any thermal throttling, but the CPU is clearly running right on the edge of its thermal limit.

Conclusion

The Nemesis Evo's small, sturdy chassis makes it easy to carry, its overclocked CPU is fast and the GTX 980 Ti is amazing in games. There's loads of storage space too, from both the SSD and hard drive, and a cracking enthusiast motherboard. As it's a mini-ITX PC, there isn't much room for upgrade, and the CPU gets very hot, but there's always an element of compromise when you buy a small system.

For the same money, Chillblast's Fusion Wolf offers a faster SSD and a more generous warranty, but the PC Specialist fights back with a slightly better all-round specification that makes it our current mini-ITX rig of choice.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING

HANDBRAKE H.264 VIDEO ENCODING

HEAVY MULTITASKING

BATTLEFIELD 4

2,560 x 1,440, Ultra Detail, 4x AA

3,840 x 2,160, Ultra Detail, 0x AA

SHADOW OF MORDOR

2,560 x 1,440, Ultra Detail

3,840 x 2,160, Very High Detail

CRYSIS 3

2,560 x 1,440, Very High Detail, 0x AA

3,840 x 2,160, Very High Detail, 0x AA

SPEED	DESIGN	OVERALL SCORE
23/25	22/25	87%
HARDWARE	VALUE	
21/25	21/25	

VERDICT

Great speed, a slick design and a well-rounded specification, although the CPU gets hot.

GAMING PC

Computer Planet Next Day 4000 i7 Gaming PC / £999 inc VAT

SUPPLIER www.computerplanet.co.uk

As its name suggests, Computer Planet's Next Day 4000 i7 Gaming PC is designed for folk who need a gaming machine in a hurry. The company's Next Day PCs are pre-built and tested so they can be delivered within 24 hours. That's an undoubted boon, and Computer Planet even allows this system to be customised to a degree, despite the short lead time; the CPU can be overclocked, the memory, graphics card and storage can all be altered, and optical drives, wireless cards and sound cards can be added.

Customisation changes alter the cost, of course. Doubling the memory to 16GB (2 x 8GB) adds £40, and fitting a GTX 980 puts £192 on the price. It's another £100 for a 480GB SSD, and then £72 to fit a 2TB hard disk.

Our sample uses NZXT's excellent Source 340 chassis, which has a glossy black façade. There's a huge side panel window too, and the bottom of the case is dominated by a metal shroud that holds two SSD bays and covers up the power supply and drives, and the right-hand side is home to a glossy vertical cover that hides cables. The cover and shroud, when combined with the PSU's black wiring, makes the interior look spotless; the GPU power cables emerge from the bottom shroud and are lashed together tightly. Cables are tied perfectly around the back too.

On the downside, though, the narrow Gigabyte motherboard means the processor sits too close to the Corsair H80i cooler, so you can't access the CPU without removing the cooler. Storage room is a little tight too: there's one spare 2.5in bay on top of the shroud, a couple of 3.5in bays around the back and no room for an optical drive.

Interestingly, the PC also has a Radeon R9 380 graphics card. It's the first time we've seen one of these cards but, while it has AMD's latest branding, it recycles the Tonga Pro core from last year's R9 285. It has 1,792 stream processors, but also a minor speed bump – the older card's 918MHz core and 5,500MHz (effective) memory clocks have been raised to 970MHz and 5,700MHz. The card in this machine has been given a helping hand by MSI too – the GPU core runs at 1GHz in its OC mode.

Meanwhile, the CPU is a Core i7-4790K that's been overclocked from 4GHz to 4.6GHz, which is great. Computer Planet has also installed 8GB of 1,600MHz DDR3, RAM which is fine, but it's on a single module, so it only runs in single-channel mode. Thankfully, you can order the PC with dual-channel RAM for free if you call or email Computer Planet, but it's s a disappointing default decision that will hinder performance.

/SPECIFICATIONS

CPU 4GHz Intel Core i7-4790K overclocked to 4.6GHz

Motherboard Gigabyte GA-Z97P-D3

Memory 8GB 1,600MHz Corsair Vengeance DDR3

Graphics MSI Radeon R9 380 4GB

Storage 240GB Mushkin Chronos SSD

Case NZXT Source 340

Cooling CPU: Corsair H80i with two 120mm fans; GPU: 2 x 80mm fans; Front: 1 x 120mm fan; top: 1 x 120mm fan

PSU Corsair CX750M 750W

Ports Front: 2 x USB 3, 2 x audio; rear: 2 x USB 3, 4 x USB 2, 2 x PS/2, 1 x Gigabit Ethernet, 3 x audio

Operating system Windows 7 Home Premium 64-bit

Warranty Two years parts and labour collect and return, with a third year labour-only return to base

The storage situation is a tad disappointing too. The SSD offers a moderate 240GB capacity, but there's no hard disk, so there's little room for extra data storage, or to install games when the SSD runs out of space.

Meanwhile, the Gigabyte Z97P-D3 motherboard has a solid basic specification, but the second 16x PCI-E slot runs at just 4x speed and there's no M/2 port for adding super-fast storage later. There are also only two USB 3 ports on the back, and its I/O has no extras such as a clear-CMOS button or optical output. It does the job, but it's definitely a basic board.

On the plus side, the Computer Planet has a decent warranty. There are two years of parts coverage with a collect-and-return service, and a further year of return-to-base labour coverage is included too.

Performance

The Computer Planet delivered competent application benchmark results. Its image editing score of 62,238 is solid, as its encoding score of 260,054. This overall system score of 117,801 is reasonable, but it's also behind the 124,224 of the Chillblast Fusion Wolf (see p56), which is only clocked at 4.4GHz, possibly demonstrating the performance cost of going for single-channel memory and a basic motherboard.

Likewise, while we applaud the use of solid state storage, the Mushkin SSD isn't a speed demon – its sequential read speed of 335MB/sec in our test isn't bad, but its 165MB/sec write speed is comparatively slow.

Meanwhile, the R9 380 proved a capable 1080p card in our tests. Its Battlefield 4 and Shadow of Mordor minimums of 38fps and 46fps are good, and it managed a playable 30fps minimum in Crysis 3 too.

At 2,560 x 1,440 the new AMD card's performance was less clear-cut though. Its Battlefield 4 minimum of 25fps just about maintains playability, and its minimum of 33fps in Shadow of Mordor was fine. As ever, though, Crysis 3 proved the toughest test, with a 20fps minimum being too slow for smooth gameplay.

1 **The MSI Radeon R9 380 graphics card is fine for 1080p gaming**

2 **Only one DIMM is supplied by default, but we recommend getting two in order to enable dual-channel mode**

3 **With some help from a Corsair H80i, the Core i7-4790K CPU is overclocked to 4.6GHz**

Sadly, this machine's noise levels were also far too high during our stress-tests – it's one of the loudest recent systems we've tested. On the plus side, that fan noise meant temperatures were fine. The processor and graphics delta Ts of 62°C and 38°C respectively are no cause for concern.

Conclusion

It's great to see you can order a decent-spec machine and receive it within 24 hours, and Computer Planet's speedy machine gets off to a good start: the chassis is spacious and the rig is tidily assembled, and there's no denying the power of the overclocked Core i7 processor. However, the default single-channel memory hinders performance, the Mushkin SSD is slow and the machine pumps out plenty of noise. It's up against strong competition too.

As a point of comparison, the Box Cube Aero Series Watercooled Gaming (see Issue 143, p56) we saw last month cost the same price, but included a GeForce GTX 970 for gaming at 2,560 x 1,440, a hard drive and a faster SSD. The Computer Planet is a solid 1080p gaming machine, but it's only really worth considering if you want a gaming PC in a hurry.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING

HANDBRAKE H.264 VIDEO ENCODING

LUXMARK OPENCL

HEAVY MULTITASKING

SYSTEM SCORE

INTEL REFERENCE: 102.93%

BATTLEFIELD 4

1,920 x 1,080, Ultra Detail, 4x AA

2,560 x 1,440, Ultra Detail, 0x AA

SHADOW OF MORDOR

1,920 x 1,080, Ultra Detail

2,560 x 1,440, Very High Detail

CRYSIS 3

1,920 x 1,080, Very High Detail, 0x AA

2,560 x 1,440, Very High Detail, 0x AA

Minimum Average

SPEED	DESIGN	OVERALL SCORE
20/25	20/25	76%
HARDWARE	VALUE	
18/25	18/25	

VERDICT

Well-built, quickly delivered and fine for 1080p gaming, but it's also noisy and let down by some component choices.

Elite

Our choice of the best hardware available

Build a mini APU PC UPDATED

The parts you'll need to build an affordable, general-purpose mini PC that's ideal for putting in the lounge, based on an AMD APU. This machine will handle general computing and media tasks with no trouble, as well as basic gaming, although you'll have to lower the detail settings.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	SilverStone Fortress FTZ01	www.scan.co.uk	Issue 144, p84	£109
	Gigabyte F2A88XN-WiFi	www.cclonline.com	Issue 144, p84	£78
	AMD A10-7870K	www.ebuyer.com	Issue 144, p22	£105
	8GB Corsair Vengeance Pro 2,400MHz (CMY8GX3M2A2400C11R)	www.scan.co.uk	Issue 144, p84	£48
	Cooler Master Seidon 120V	www.scan.co.uk	Issue 144, p84	£36
	256GB Crucial BX100	www.ebuyer.com	Issue 144, p84	£68
	SilverStone SST-ST30SF	www.scan.co.uk	Issue 144, p84	£42
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£554

Build a budget gaming PC UPDATED

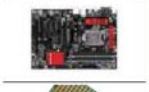
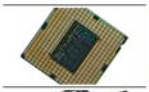
The parts you'll need to build a budget machine capable of playing the latest games at maximum settings on a 1080p monitor. The machine has a discrete graphics card, a highly overclockable dual-core CPU and high-speed memory. Meanwhile, the Z97 motherboard gives you headroom to upgrade to a faster CPU later.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	ASRock Z97 Pro3	www.scan.co.uk	Issue 130, p50	£79
	Intel Pentium G3258	www.scan.co.uk	Issue 132, p17	£51
	8GB Corsair Vengeance Pro 2,400MHz DDR3 CMY8GX3M2A2400C11R	www.scan.co.uk	Issue 132, p22	£48
	AMD Radeon R9 280 3GB	www.ebuyer.com	Issue 140, p42	£152
	256GB Crucial BX100	www.ebuyer.com	Issue 144, p84	£68
	SilverStone Argon AR01	www.scan.co.uk	Issue 132, p57	£26
	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£64
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£58
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£674

Build a mid-range PC

Work PC

The parts you'll need to build a solid quad-core PC with plenty of upgrade potential. This kit list gives you an all-in-one liquid cooler and a K-series Core i5 CPU, meaning you can overclock it and get some serious processing power. We've managed to get the Core i5-4690K Haswell CPU up to 4.8GHz, so it has some serious performance potential. Also included is a solid Corsair PSU, a 500GB SSD and 8GB of high-speed memory. The core configuration assumes you won't be doing any serious gaming, however, and it relies on Intel's integrated graphics.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT Phantom 530	www.overclockers.co.uk	Issue 127, p44	£98
	Gigabyte Z97X-SLI	www.overclockers.co.uk	Issue 130, p54	£90
	Intel Core i5-4690K	www.scan.co.uk	Issue 132, p18	£186
	8GB Corsair Vengeance Pro Series 2,400MHz DDR3 CMY8GX3M2A2400C11R	www.scan.co.uk	Issue 132, p22	£48
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£70
	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£64
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£58
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£131
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£823

Gaming PC

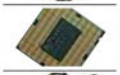
The graphics card you'll need to play current games at their maximum settings at 1080p and 2,560 x 1,440.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**1,920 x 1,080** AMD Radeon R9 280 3GB	www.ebuyer.com	Issue 140, p42	£152
	**2,560 x 1,440** Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£251

Build a performance PC

Work PC

The parts you'll need to build a high-quality, fast PC that's ideal for multi-threaded workloads. This kit list features a high-quality, beautifully built case, and has a Core i7-4790K CPU. This processor's support for Hyper-Threading effectively splits the resources of the CPU's four physical cores into a further four virtual cores, meaning it can effectively handle eight threads at once. There's also a solid 850W PSU, giving you plenty of headroom for overclocking and adding multiple graphics cards, and an all-in-one liquid cooler.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Cooler Master Cosmos SE UPDATED	www.cclonline.com	Issue 144, p41	£125
	Asus Maximus VII Ranger	www.scan.co.uk	Issue 131, p20	£130
	Intel Core i7-4790K	www.scan.co.uk	Issue 132, p19	£268
	8GB Corsair Vengeance Pro Series 2,400MHz DDR3	www.scan.co.uk	Issue 132, p22	£48
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£70
	SilverStone Strider Gold 850W	www.overclockers.co.uk	Issue 135, p56	£110
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£58
	Samsung 850 Evo 500GB	www.scan.co.uk	Issue 141, p51	£146
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£1,023

Gaming PC

The graphics card you'll need to play current games at their maximum settings at 2,560 x 1,440 and beyond.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**2,560 x 1,440** Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£251
	**4K** 2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p50	£502

Recommended extra

A discrete sound card gives you higher-quality sound when playing back or recording music.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Creative Sound Blaster Z	www.scan.co.uk	Issue 116, p42	£62

Build a 6-core workstation

Multi-threaded workstation

The parts you'll need to build a PC with serious power in multi-threaded workstation software, such as 3D rendering apps and optimised distributed computing software. The kit list features a 6-core LGA2011-v3 CPU, which is overclockable using the motherboard and cooler listed. Also supplied is 16GB of RAM, 1TB of solid state storage and a 1.2kW PSU, providing loads of headroom for adding multiple GPUs.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Phanteks Enthoo Luxe UPDATED	www.cclonline.com	Issue 144, p53	£118
	Asus X99 Deluxe	www.overclockers.co.uk	Issue 136, p20	£300
	Intel Core i7-5820K	www.scan.co.uk	Issue 134, p43	£303
	AMD Radeon R9 280 3GB	www.ebuyer.com	Issue 140, p42	£152
	16GB Corsair Vengeance LPX 2,666MHz DDR4 CMK16GX4M4A2666C16	www.scan.co.uk	Issue 136, p14	£123
	Corsair Hydro Series H110i GT	www.scan.co.uk	Issue 140, p17	£101
	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£253
	Samsung 850 Evo 1TB	www.cclonline.com	Issue 141, p51	£289
	Seagate Barracuda 2TB ST2000DM0001	www.scan.co.uk	Issue 104, p75	£58
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Microsoft Windows 7 Professional OEM (or Windows 8.1 if you're using a 4K monitor)	www.ebuyer.com	Issue 75, p46	£111
			TOTAL	£1,818

4K gaming PC

This LGA2011-v3 system can support multiple graphics cards over 28 PCI-E 3 lanes, making it an ideal foundation for high-resolution PC gaming, replacing the graphics card listed above with two high-spec cards. We recommend using Windows 8.1, rather than Windows 7, if you're using a 4K monitor.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**4K** 2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p50	£502
			TOTAL	£2,168

Build a mini PC

Core components

The parts you'll need to build either PC. This kit list gives you a solid PSU, 8GB of RAM, an overclockable Haswell CPU, an all-in-one liquid cooler and Windows 7 Home Premium. Also included is a short-PCB graphics card that can play current games at their maximum settings at 2,560 x 1,440, and a 512GB SSD.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Intel Core i5-4690K	www.scan.co.uk	Issue 132, p18	£186
	8GB Corsair Vengeance Pro Series 2,400MHz DDR3	www.scan.co.uk	Issue 132, p22	£48
	Corsair H75	www.scan.co.uk	Issue 138, p46	£63
	Asus GeForce GTX 970 DirectCU Mini	www.overclockers.co.uk	Issue 139, p20	£290
	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£131
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£58
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£64
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68

Mini-ITX PC

The parts you'll need to build a pint-sized powerhouse.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Corsair Obsidian 250D	www.scan.co.uk	Issue 136, p41	£74
	Asus Maximus VII Impact	www.overclockers.co.uk	Issue 136, p52	£183
			TOTAL	£1,175

Micro-ATX PC

The parts you'll need to build a mini PC that doesn't take up as much room as a full-sized desktop.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£66
	Asus Maximus VII Gene	www.overclockers.co.uk	Issue 133, p18	£160
			TOTAL	£1,144

Cases

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Budget ATX**	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	**Sub-£100 ATX quiet**	Fractal Design Define R5	www.scan.co.uk	Issue 137, p20	£87
	**Sub-£100 ATX performance**	NZXT Phantom 530	www.overclockers.co.uk	Issue 127, p44	£98
	**Sub-£150 full-sized ATX quiet**	Nanoxia Deep Silence 5 UPDATED	www.quietpc.com	Issue 144, p50	£115
	**Sub-£150 full-sized ATX**	Phanteks Enthoo Luxe UPDATED	www.cclonline.com	Issue 144, p53	£118
	**Sub-£150 mid-size ATX**	Cooler Master Cosmos SE UPDATED	www.cclonline.com	Issue 144, p41	£125
	**Mini-ITX tower**	Corsair Obsidian 250D	www.scan.co.uk	Issue 136, p41	£74
	**Mini-ITX cube**	Antec ISK600	www.overclockers.co.uk	Issue 126, p28	£50
	**Micro-ATX**	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£66
	**Water-cooling micro-ATX**	Parvum Systems S2.0	www.overclockers.co.uk	Issue 129, p22	£140

Graphics cards

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**1,920 x 1,080 gaming**	AMD Radeon R9 280 3GB	www.ebuyer.com	Issue 140, p42	£152
	**2,560 x 1,440 gaming**	Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£251
	**High-end single-GPU gaming**	Nvidia GeForce GTX 980 Ti	www.overclockers.co.uk	Issue 143, p20	£530
	**4K gaming**	2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p49	£502
	**Mini-ITX**	Asus GeForce GTX 970 DirectCU Mini	www.overclockers.co.uk	Issue 139, p20	£290

Power supplies

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Mid-range 550W**	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£64
	**High-end 750W**	Corsair HX750i	www.dabs.com	Issue 135, p52	£115
	**Mid-range 850W**	SilverStone Strider Gold 850W	www.overclockers.co.uk	Issue 135, p56	£110
	**High-end 1.2kW**	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£253

Networking

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Router**	Asus RT-AC68U	www.dabs.com	Issue 128, p88	£134
	**Wi-Fi adaptor**	Asus PCE-AC68	www.dabs.com	Issue 128, p88	£70

Storage

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Hard disk**	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£58
	**250GB SSD**	Crucial BX100 250GB	www.ebuyer.com	Issue 141, p43	£68
	**500GB SSD**	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£131
	**1TB SSD**	Samsung 850 Evo 1TB	www.cclonline.com	Issue 141, p51	£289
	**High-performance SSD**	Intel SSD 750 1.2TB	www.scan.co.uk	Issue 143, p24	£833
	**NAS box**	Synology DS215J	www.cclonline.com	Issue 138, p17	£140

Monitors

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**24in monitor**	Dell U2414H	www.overclockers.co.uk	Issue 129, p43	£200
	**29in monitor**	Asus PB298Q	www.scan.co.uk	Issue 129, p52	£293
	**28in 4K monitor**	Asus PB287Q	www.scan.co.uk	Issue 133, p44	£393
	**G-Sync monitor**	Asus ROG Swift PG278Q	www.scan.co.uk	Issue 143, p44	£587
	**FreeSync monitor**	BenQ XL2730Z	www.overclockers.co.uk	Issue 143, p46	£500

Peripherals

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Budget mechanical keyboard**	Gigabyte Aivia Osmium	www.awd-it.co.uk	Issue 139, p40	£72
	**Mechanical gaming keyboard**	CM Storm Trigger-Z	www.ebuyer.com	Issue 139, p44	£87
	**Mechanical MMO keyboard**	Corsair Vengeance K95	www.awd-it.co.uk	Issue 123, p64	£125
	**Gaming mouse**	Logitech G402 Hyperion Fury	www.currys.co.uk	Issue 139, p53	£35
	**Wireless gaming mouse**	SteelSeries Sensei Wireless	www.ebuyer.com	Issue 139, p61	£90
	**Flight stick**	Saitek X-55 Rhino H.O.T.A.S.	www.overclockers.co.uk	Issue 131, p29	£170
	**Steering wheel and pedals**	Thrustmaster TX Ferrari 458 Italia Edition	www.overclockers.co.uk	Issue 137, p32	£260

Audio

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**PCI-E sound card**	Creative Sound Blaster Z	www.scan.co.uk	Issue 116, p42	£62
	**USB DAC**	Asus Xonar Essence One	www.overclockers.co.uk	Issue 118, p44	£363
	**2.1 speakers**	Acoustic Energy Aego M	www.amazon.co.uk	Issue 142, p52	£165
	**Soundbar**	Razer Leviathan	www.overclockers.co.uk	Issue 142, p57	£165
	**Headset**	HyperX Cloud II	www.ebuyer.com	Issue 142, p46	£75
	**Surround-sound headset**	Asus Strix 7.1	www.cclonline.com	Issue 142, p43	£145

Systems

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	**Sub-1,000 gaming PC**	Box Cube Aero Series Watercooled Gaming	www.box.co.uk	Issue 143, p56	c.£999
	**Quiet gaming PC**	Chillblast Fusion Serenity	www.chillblast.co.uk	Issue 138, p66	c. £1,499
	**Dream PC**	Scan 3XS Bear	www.scan.co.uk	Issue 125, p58	c.£6,999
	**Sub-£2,000 gaming PC**	Scan 3XS X99 Carbon Ti	www.scan.co.uk	Issue 143, p58	c.£1,999
	**4K gaming PC**	Overclockers Infin8 Nebula	www.overclockers.co.uk	Issue 141, p58	c. £3,116
	**Mini-ITX PC**	PC Specialist Nemesis Evo UPDATED	www.pcspecialist.co.uk	Issue 144, p58	£1,599
	**Gaming laptop**	MSI GT70 2PC Dominator	www.overclockers.co.uk	Issue 129, p26	c. £1,320
	**Haswell-E PC**	Scan 3XS X99 Cyclone SLI	www.scan.co.uk	Issue 134, p60	c.£3,349

Games

Featured this month

RICK LANE / INVERSE LOOK

ONE CITY BLOCK

The concept of a small yet incredibly deep game has tantalised developers for years, but Rick Lane asks if this goal is still worth chasing

At the back of my mind, there's a list of games I hope will one day be made. I don't mean specific games such as System Shock 3 or a new Elder Scrolls, but types of games that haven't been made yet. I've yearned for a space game where you could land on and explore planets, for example, and now there are several such projects in the works, including Hello Games' exciting No Man's Sky.

In fact, many games have been ticked off this list recently, but there's still one I've yet to see. It's a detective game with the budget of a huge open-city game such as GTA or Watch_Dogs. Yet instead of creating such a city, it would dedicate the same effort into recreating a village or a small town, focusing on depth rather than size.

Every building in the village could be entered and explored, every drawer opened in the bedroom, every item picked up and examined. The same level of detail would be applied to people. Every character would have their own routine, behaviour patterns and personality, and be capable of interacting with every other character in the village. In the middle of it all would be you, the detective, and how you interacted with all these characters would affect their relationship with you and the ultimate outcome of the story.

Similar dream games have been envisioned by developers over the years. The most significant is Warren Spector's One City Block concept, which is based on the same principles of detail and exacting simulation, but frames it around a city block. Recently, however, I've started to question whether One City Block will ever happen. Not because it's impossible, but because it's too possible. Two recent games are responsible for this rethink – GTA V and the Witcher 3.

> While wandering the streets of GTA V's Los Santos, I stopped off at Franklin's house to pop a beer and watch a little TV

While wandering around the streets of GTA V's Los Santos, I stopped off at Franklin's house to pop a beer and watch a little TV, and I then realised that even these huge games are approaching the same level of environmental detail I imagined in my village murder mystery.

As you'll discover in more detail over the page, The Witcher 3: Wild Hunt reinforced this feeling, cramming vast amounts of detail not just into the game's environment, but into its characters and quest structures too. When a game world feels that real, does the One City Block dream still apply? I think now it's less about the viability of the concept, and more about the type of game a developer wants to make.

Although GTA V's world looks incredibly detailed, a lot of it is still window dressing, and while all of The Witcher 3's characters are incredibly well written, many of them still act merely as quest dispensers. These foundations are still based on traditional game design.

Moreover, these games represent a world, whereas my version of One City Block is more about simulating a community. It's about creating a world in which character interactions are the core of the experience, the rumours they spread about one another, the gossip, the fallouts, the love tangles and the family dramas. It's almost like the Sims, but without the sanitised, capitalist utopianism.

I still believe the principles of One City Block are an ideal goal for games. The question is whether we still need a game of limited scope and innovative design to achieve it, or whether we'll arrive at that point in a more brute-force fashion, via shades of increasingly detailed massive open worlds. CPC

Rick Lane is Custom PC's games editor. @Rick_Lane

The Witcher 3: Wild Hunt / £39.99 inc VAT

CUSTOM PC PREMIUM GRADE

DEVELOPER CD Projekt RED / **PUBLISHER** CD Projekt / **WEBSITE** www.thewitcher.com

It's been a strong 12 months for fantasy RPGs. Last year's Dragon Age: Inquisition was an impressive slab of adventuring action from BioWare, and Obsidian's Pillars of Eternity was even better. The Witcher 3 blows them both out of the water. In fact, it sets a new standard for RPGs, combining a more impressive open world than Bethesda's best offerings, with a depth of storytelling we haven't seen in a game for a very long time.

Wild Hunt continues the story of the witcher Geralt of Rivia, a professional monster hunter who, despite his best efforts, has a tendency to get involved in other people's problems. Sometimes it's a spat between two peasant families over a curse one has inflicted on the other; sometimes it's a debate over the fate of an entire country.

This time, Geralt also seeks to solve a personal problem. His adoptive daughter Ciri, who vanished prior to the events of the first game, has abruptly returned, smack in the middle of a war between two powerful nation states, while also being pursued by a gang of inter-dimensional riders known as the Wild Hunt. To track her down, Geralt must wade into the middle of this war, while dealing with criminal gangs seeking to profit from the chaos, witch hunters who burn anyone that so much as performs a card trick, and hordes of monsters growing fat on the corpses rotting on the battlefields.

The Witcher games are based on the works of Polish author Andrzej Sapkowski, whose fantasy world sits between the Brothers Grimm's Teutonic fables and George R R Martin's brutal fantasy. In The Witcher 3, CD Projekt has replicated this world in gorgeous, earthy detail. The roads are thick with mud, the peasants eye you warily as you ride through their squat, smoky villages and the wind whispers eerily through beautiful forests.

The world is split into three main areas. To the south is the battle-scarred no man's land of Velen. To the north is the bustling city of Novigrad and the picturesque farmland that surrounds it. To the west are the Skellige isles, where the only elements harsher and colder than the climate are the people who inhabit this frostbitten land. It's a truly enormous world, but even more impressive than the scale is the amount of stuff you can do in it. There are bandit camps and monster dens that can be cleared in a matter of moments, abandoned communities that can be restored to life and vast, twisting ruins and caves that conceal abundant hidden treasures.

Remarkably few of these activities are cut-and-paste tasks, like the ones in many other open-world games. The vast majority of them have been created with painstaking care and craft. What's more, they're the tip of the iceberg when it comes to The Witcher 3's depth and detail.

> Every line of dialogue is sharply written and laced with humour

For starters, Wild Hunt sees the introduction of Witcher Contracts – dedicated monster-hunting quests that see Geralt investigating scenes of monster attacks, before tracking down the creature responsible and dispatching it in single combat. These missions act as showcases for the superbly designed monsters, but they equally serve as fascinating detective stories that rarely end as you expect. The process of investigating is rather simplistic, but the missions are cleverly structured, suspenseful and consistently engaging, making you feel like a real tracker.

The entire game is similarly rich and sumptuous, nuanced and deep. Fleeting characters, such as shop vendors and quest givers, have clearly defined personalities, while every line of dialogue is sharply written and laced with humour that's, by turns, wry, bawdy and dark. Meanwhile, the

game's 'secondary quests' are sprawling adventures that span multiple missions, sometimes branching out into additional sub-quests. A simple bit of tavern redecoration turns into a murder mystery that encompasses the entire city of Novigrad, while in Skellige, there's a huge island dedicated to a single, massive side-quest.

Then there's the main story itself, a simultaneously grand yet deeply personal adventure that involves one of the most diverse and empathetic cast of characters seen in any video game. We see far much more of Geralt's character than in previous Witcher games, brought out by his paternal feelings for Ciri, and reuniting with friends and lovers. His emotional state is conveyed with wonderful subtlety too, with little flickers in his expression that say as much as any of his spoken dialogue.

Wild Hunt also features some of the best female characters seen in a game. There's Ciri herself, as warm and earnest as she is dangerous. She's even playable in certain sections of the game. Alongside Ciri is a group of sorceresses, including the bubbly and devoted Triss Merigold, the spiky and impulsive Yennefer, and the arrogant and scheming Phillipa Eilhart. CD Projekt slightly spoils the effect of these great female characters with the odd bit of tawdriness though. Noivgrad seems to have more prostitutes than guardsmen, while the peasant women of Velen are worryingly underdressed for such an obviously chilly climate.

Yet for every time the game's narrative or character portrayals stumble, there's a dozen instances where they excel. Wild Hunt is capable of being funny, touching, uplifting, sad, contemplative and dark as a forest night. It tackles difficult subjects, such as domestic abuse and racism, with tact and thoughtfulness that even BioWare would struggle to achieve, although it would also be good to see some more non-white faces among The Witcher 3's characters. And you're always an active participant, expected to make impossible choices that will change and often end lives. Sometimes the consequences remain unseen until hours, even days after the decision was made.

There's so much that we haven't discussed yet, such as the fantastically improved combat system, which is lithe, fast-paced and viciously bloody, or the incredible soundtrack, which dispenses with much of the popular Hans Zimmer-esque bombast in favour of a blend of Eastern European folk music and haunting Gaelic song.

Of course, there are some problems. Technically, it's pretty demanding (see our performance analysis on p90), and it's also prone to the odd crash. In game terms, moving around in confined spaces is rather awkward too, while levelling and ability unlocks aren't that exciting. If you enjoy stats and thoughtful tactics, Wild Hunt isn't the game for you.

If, however, you like great storytelling, smart dialogue, brilliant characters, thrilling swordplay, ambiguous decision making, astonishing world building, terrifying monsters, sex, swearing, shocks, violence and witty, foul-mouthed swamp children, The Witcher 3 is an absolute must. RPGs have a new champion, and his name is Geralt of Rivia.

RICK LANE

OVERALL SCORE
95%

/ VERDICT
Epic, intimate and astoundingly deep, The Witcher 3 represents a new high point for fantasy RPGs.

Invisible, Inc / £15 inc VAT

DEVELOPER Klei Entertainment / **PUBLISHER** Klei Entertainment / **WEBSITE** www.invisibleincgame.com

Invisible, Inc is a superb little game about breaking into futuristic, high-security facilities, slipping through guard patrols and making off with whatever gadgetry you can carry in your trenchcoat pockets. It's equal parts spy game and heist game, focusing on intense stealth action through turn-based strategy. It also has more style than James Bond visiting London Fashion Week.

Played from an isometric perspective, each mission sees you taking turns to move up to four spies round a high-tech chessboard littered with deadly guards, watchful cameras and laser-grid alarm systems. When you've completed your main objective, you must escape via a teleporter on the map. You can also access a high-powered AI system, which you can use to hack into security systems, unlock doors and switch off hazards.

All the missions are randomly generated – one of two systems used to create suspense and encourage fast decision making. The other is an ingeniously designed alarm sequence. At the end of every turn, the building's security level increases slightly, and every five turns, the alarm level is raised, meaning more guards, more cameras and other nasty surprises for your agents. As a result, you need to be efficient and able to react to an escalating threat. Do you locate the exit elevator first, or proceed with the mission and hope you come across it later?

Missions are stitched together in a short, sharp campaign that gives you just 72 in-game hours to bring down several giant technology corporations hunting your group of hackers and spies. Achieving this goal requires all the help you can get; every agent you can rescue, every weapon you can steal, and every credit chit you can scrape from those randomly generated missions.

OVERALL SCORE 90%

/ VERDICT
Stylish yet deep, fast-paced yet thoughtful, Invisible, Inc is one of this year's highlights.

Kholat / £15 inc VAT

DEVELOPER IMGN.PRO / **PUBLISHER** IMGN.PRO / **WEBSITE** http://kholat.com

Kholat piqued our interest because it's based on the Dylatov Pass Incident of 1959, in which a group of nine hikers went into the Russian Ural mountains, and were all found dead three weeks later in circumstances yet to be explained. It's also one of the first games powered by the mighty Unreal Engine 4, and is narrated by the Warden of the North himself, Sean Bean.

Kholat uses this real-life mystery as a springboard for a walking simulator-cum-horror game about exploring an expanse of rugged, snow-blasted mountainside, collecting notes and diary entries that unravel the game's mystery. You also have to evade monsters and listen to big chunks of Bean's monologues inside your character's head.

At first Kholat looks promising. The atmosphere is foreboding, creepy and so chilly you can almost feel the wind through your monitor as it whips the snow into a frenzy and rustles through the wintry forests.

Kholat also requires you to navigate its harsh wilderness using a map and compass, which is obviously intended to give you a sense of the disorientation and confusion that the victims of the Dylatov Pass incident likely felt themselves.

Unfortunately, Kholat pushes its confusion aspect way too far. Although the environments are pretty, the actual level design is atrocious. You can only get to important locations by bumbling through mazy, artificial-feeling corridors that often seem to lead *away* from where you want to go. Worse, your character is incapable of climbing, jumping or even stepping over a small log, so your progress is regularly impeded by barriers mere inches

OVERALL SCORE 45%

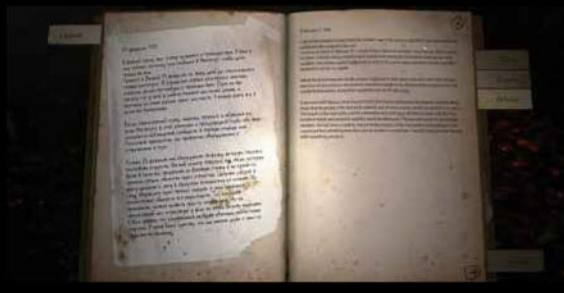
/ VERDICT
Incredible visuals and A-list acting talent can't prevent Kholat from being a confusing and frustrating mess.

Of course, the longer you spend clearing every inch of a level, the more difficult it becomes to escape without casualties, and every dead agent or failed mission massively impacts your broader chances of survival. And that's where Invisible, Inc's genius reveals itself. You can't merely think about the short term, you must play the long game, but not too long, or you'll go into the final mission massively underprepared.

Failure is part of the fun, and the tight campaign length (around six hours in real time) make a botched run more bearable than in the bulkier XCOM: Enemy Unknown. Even if you're victorious first time, the game encourages multiple playthroughs anyway, with a wide range of difficulty and challenge modes.

There are few flaws too. The story is fairly slight, mostly comprising of three or four brief cutscenes. But Invisible, Inc is more about creating your own spy thriller, with its tense bank heists, last-minute escapes and heartbreaking sacrifices. In this regard, it's utterly excellent.

RICK LANE



in height, completely shattering the immersion.

The developers combine this horrible level layout with a save system that only functions when you near a campsite or pick up a written note, and then cap it off with frequent, immediate and unexpected death. The blizzard is prowled by ghostly monsters that you're supposed to evade, but the game never establishes the rules behind its stealth systems, and whether a monster spots you or not seems entirely down to chance. If it catches you, though, you're dead. You're also dead if you fall into one of the spike pits that are completely concealed by the snow.

These flaws might be forgivable if the central mystery was interesting. But instead it's plain bamboozling. The various narrative threads you explore feel disjointed, and Sean Bean's monologues (which are delivered with gusto) consist of vague, self-indulgent prose that read like the angst-ridden ramblings of a teenage goth. You aren't even given any information about the character you're playing either – you simply start outside a train station.

Kholat is a disappointment that doesn't deserve to be based on the real-life tragedy by which it's inspired. That's a shame, because the developers clearly have the budget and artistic capability to create a great game, but they need a crash course in game design before their next outing.

RICK LANE

Her Story / £5 incVAT

DEVELOPER Sam Barlow / **PUBLISHER** Sam Barlow / **WEBSITE** www.herstorygame.com

Detective games are a tough virtual nut to crack. How do you reduce a job that requires supreme skill and years of experience into a game without making it feel insipid? Most detective games adopt a Scooby Doo formula; laying out footprints, clues and other breadcrumb trails for you to follow around the various story points. There aren't any breadcrumbs in Her Story, though, or a grand reveal, where the game rips off the culprit's mask and shouts 'Mister Simmons! The owner of the abandoned amusement park?!' Instead, it's all about listening, observing and making deductions by yourself.

Playing Her Story is straightforward. The screen displays a computer desktop that provides access to a database of old videotapes – specifically, a police interview with a woman regarding the disappearance of a man named Simon. Somehow, these videos have become chopped up into short clips, and scrambled inside the database.

Searching the database using keywords (the game starts you off with the word 'murder') will bring up some of these clips, drip-feeding you more information about the woman, her relationship with Simon and the circumstances surrounding his disappearance. During the interviews, she mentions certain phrases, such as the name of a person or place, giving you further clues to search for so you can reveal additional clips. Through this method you gradually piece together the sequence of events.

The quality of both the writing and acting is top-notch – emotive, believable and chilling. The plot is intricately layered so that you can approach it from several angles, each offering different discoveries to help you complete the picture. It's also structured so that you can walk away at any point and still receive a conclusion of sorts, even if you haven't fully solved the mystery.

Certain elements of the tale are rather implausible, but they're grounded by the superb performance given by Viva Seifert. Her Story ventures into some pretty dark territory, which could easily be spoiled by soap-opera-esque yelling or crying, but Seifert lends wonderful subtlety to the role, encouraging empathy even as it becomes clear that her character is hiding a big secret. The only issue is that the character Seifert play is apparently still a teenager, yet she carries and articulates herself with the composure and maturity of a much older person.

There's also little else to Her Story – there's no additional documentation or other kinds of evidence to flesh out the mystery or the community the characters inhabit. As a result, certain deductive methods, such as seeking out inconsistencies in Seifert's tale, are limited.

Nevertheless, to take what's essentially a collection of chopped-up videos and produce such an engrossing tale is an impressive achievement, making Her Story easily worth the price of a London pint.

RICK LANE

OVERALL SCORE
80%

/ VERDICT
It might be simple, but superb writing and a brilliant lead performance make Her Story a captivating mystery game.

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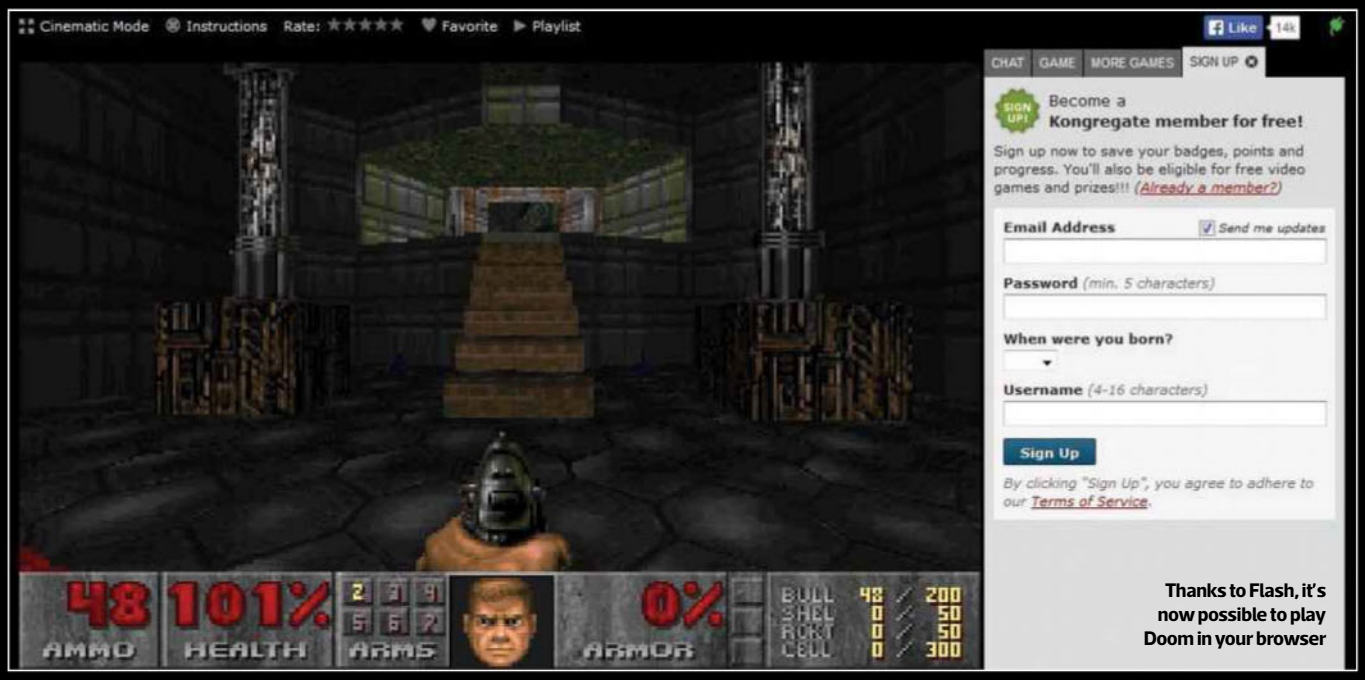


Thanks to Flash, it's now possible to play Doom in your browser

RICK LANE / THE ENGINE ROOM

Adobe Flash

Flash games don't have to be simple. Rick Lane investigates the development of survival sim, and Flash game, NEO Scavenger

For over a decade, Flash has been the primary platform for online media, the basis of snazzy websites, animated videos and thousands of freely available browser games on sites such as Newgrounds and Kongregate. Indeed, with dozens of subsidiary programs and user-created game engines to facilitate development (including Flixel, which we covered a few months back) Flash potentially has the largest game development community in existence.

In the past couple of years, however, use of Flash has begun to decline. In the browser sphere, competition has arisen from Unity and Microsoft, while Apple famously hasn't supported Flash on its iOS devices. On the desktop, Steam has made downloading games almost as immediate and accessible as their browser-based counterparts, and Adobe itself has diminished Flash's role with Adobe AIR, its purpose-built runtime system for developing desktop and mobile programs.

While its heyday might have passed, Flash can still support great games. One of the more ambitious and unusual projects of the last few years is NEO Scavenger, a turn-based survival game created by former BioWare developer Daniel Fedor. Released on Steam at the end of last year, NEO Scavenger has been in development since 2011, when the Flash gaming scene was very different.

NEO Scavenger's grid-based inventory grows and shrinks depending on the containers you're carrying

'It was a pretty viable platform back then. Flash web portals were still pretty strong,' says Fedor. 'I wanted to make the game, put it on some web portals, probably for a sponsorship fee, and the idea was for [NEO Scavenger] to be a three-month project.'

But the game quickly proved to be much more substantial than he originally anticipated. 'It evolved, and so did the business of making Flash games. Web portals were really on the decline. They've not gone away, but they're not the powerhouse they were.' Despite the lengthy development period, Fedor has no regrets about building NEO Scavenger with Flash. 'With a few caveats, it's probably the easiest game development I've ever done.'

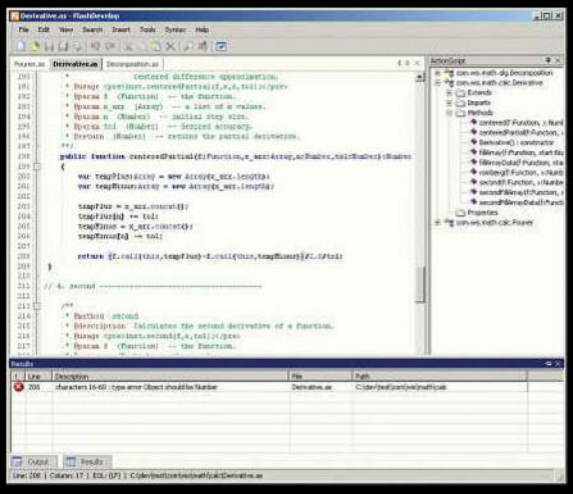
Fedor has a wide range of experiences with programming

Scavenger's Hex-based map can grow to quite a considerable size

languages, including C, C#, C++, Ogre3D and Allegro. But ActionScript 3, the code-base for Flash, stands out as his favourite, as 'the time from writing code to getting something on the screen is shorter than anything else'. Moreover, Flash is cross-platform compatible with Windows, Linux and OSX without requiring any rewrites or code tweaking, and there's a massive community on which to fall back for solutions to coding problems. 'If you have a question about how to do something in ActionScript 3, you literally have thousands of options for every question, so you'll never be wanting for an answer.'

But Fedor isn't blind to Flash's flaws, especially for creating a more traditional PC game. 'It's not a first-class desktop application, so you don't get unfettered file-system access or full screen capabilities. Adobe wants you to make AIR apps if you're going to do that, and Flash doesn't really have it built in.' The lack of desktop support also affects performance on more complex games, because desktop Flash apps have to be run on a virtual machine.

There are a few more idiosyncratic problems too. 'You can't control what the Escape key does for security reasons,' Fedor points out. 'Which is good if you're on a website, and it suddenly takes over the screen and looks like the OS – you want to be able to hit the Escape key to get out of it. But the downside is that whenever you hit the Escape key, it goes out of full-screen mode. So even when I'm playing a desktop game made in Flash, instead of going to the main menu, which most people expect, it exits full-screen mode.'



Fedor codes his game in a third-party Flash tool named FlashDevelop

NEO Scavenger is by no means a typical Flash game, of course. Behind its simple exterior lies a complicated and granular survival simulation, where hand-to-hand combat and the effects of weather are simulated with a high level of detail. Playing NEO Scavenger is a far slower and more methodical experience than much of its browser brethren.

Despite its shortcomings as a desktop application, though, Fedor doesn't believe Flash has negatively affected NEO Scavenger in terms of realising his vision. During development, Flash only proved problematic in performance optimisation. 'At some point, users are going to run into performance issues, purely because there's a lot going on and it's running through a virtual machine. Unfortunately, the version of Flash I'm using in order to maintain cross-platform compatibility, came out prior to the Stage 3D hardware stuff that's been added, so a lot of it is CPU-bound too.'

Much of NEO Scavenger is procedurally generated, with the world simulation growing in complexity as the player explores further. The heavy emphasis on procedural generation also further distances NEO Scavenger from the usual Flash fare. Much of NEO Scavenger is coded into XML files, with each one focused on a different aspect of the game, whether it's scripted encounters, creatures or the various terrain types you traverse on the game's hex-based map.

'The system was meant to read that data – sometimes it's more deterministic and sometimes it's more random/procedural – like a creature. The game will look at the player's location on the map, and which other factions are set up to be near that place. Then it decides which creatures spawn, based on asking whether the player 50 per cent closer to this faction or that one.'

The beauty of procedural systems is that they enable a designer to do much more with limited memory or software capabilities, which is useful given NEO Scavenger's browser origins. The browser basis proved less helpful when it came to NEO Scavenger's dynamic inventory system, though, where almost any container, from plastic bags to shopping trolleys, can be used to increase your carrying capacity. 'Because I somehow thought this was going to be a Flash Portal game, I limited the game to being 800 pixels wide, which was hard, but it was low-res pixel art so I could keep it all pretty tight that way. Even so, there are just so many buttons trying to show everything that a character is wearing and/or carrying, and everything that's on the ground.'

Fedor is still supporting NEO Scavenger. He hopes to release a tablet version, and is looking to build a new engine using Haxe, the OpenFL-based toolkit viewed as a potential successor to Flash. 'It's a really powerful step up from Flash,' he says, 'and I'd kind of like to get things running in that before I start investing time in new code.' CPC

CUSTOM PC MAKES A VIDEO GAME

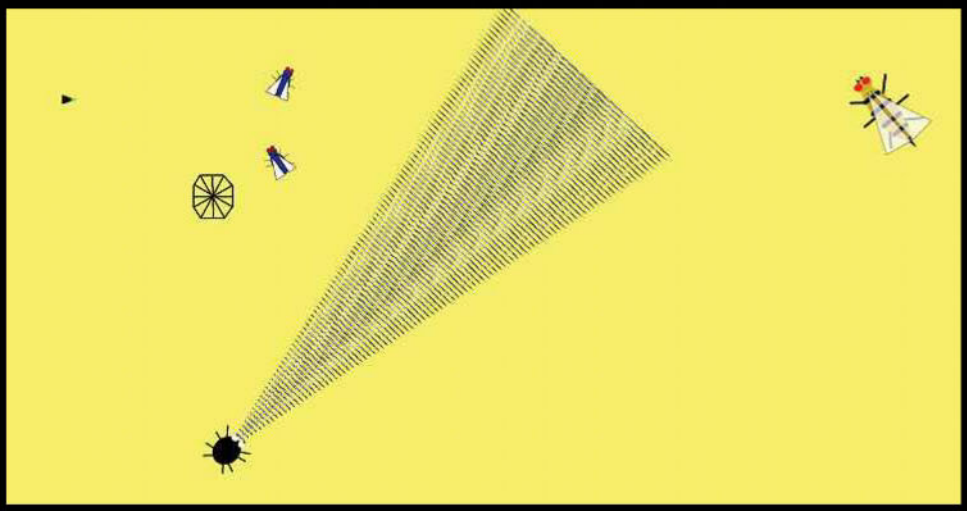
PART THREE

Shotguns, spawning and a screen-full of wasps. It's just another evening in Rick Lane's living room

In this month's game-making endeavours we fixed and then revamped the game's spawning system, added a whole new weapon and created the most nightmarish bug that you're likely to witness in any software ever. So that's something. We're building our game with YoYoGames' GameMaker studio, and nourishing our programming deficiency with Tom Francis' YouTube tutorials. So if you fancy trying your hand at game development, these two resources combine to form an ideal entry point for learning the basics.

By the end of part two, we'd made a new enemy – the wasp – and started work on a rudimentary battle escalation that would begin with the spider fighting flies, before tackling a single wasp in a kind of boss fight. Unfortunately, once the requisite number of flies (three) had appeared on screen, our game spawned three wasps; quite a jump in difficulty.

In the end, we fixed this issue by programming the game to destroy all the instances of flies on the screen *and* the specific fly that triggered the script once the correct number of flies had been reached. *Then* we commanded the program to spawn the wasp. This system might seem like overkill, but computers are completely literal, so your code needs to specify exactly what you need it to do, and it worked.



Our initial experiments with the web grenade met with mixed success

Before this little victory, however, we mistakenly wrote the code so that the game would constantly spawn wasps if there were fewer than three flies on the screen. This mistake caused the game to fill the level with wasps immediately after starting – an image that will give us nightmares for weeks.

In typical game development fashion, not long after implementing this system, we replaced it with a different one. Francis' tutorials cover an alternate spawning method, which means the game runs persistently rather than speedily escalating to an abrupt finish. This system commands the game to randomly and infinitely spawn both wasps and flies at set intervals. In GameMaker, this system is based around the simple `choose` command, which makes the code select from a set number of objects, each of which have a 50/50 chance of spawning.

It's even possible to skew the odds by specifying an object in the code multiple times, so the phrase `choose(oFly,oFly,oWasp)` doubles the chance of the game spawning a fly object over a wasp object. In our game this spawning system makes sense, as the wasps are considerably more dangerous than the flies, since they explode into a cloud of stings when killed.

Francis also demonstrates how to fix a spawning problem we'd encountered since the beginning, which is that the spider could be killed by an enemy spawning on top of it. The new spawn code only allows enemies to spawn around the

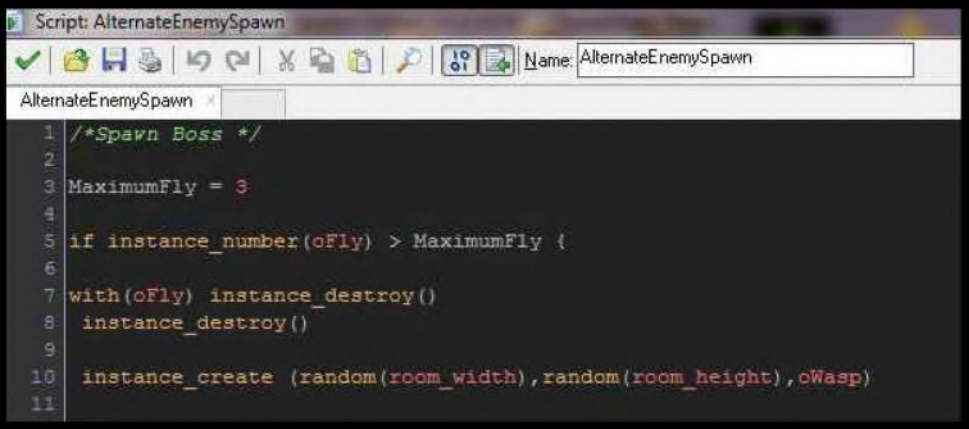
fringes of the map, eliminating this issue for the time being.

With the enemy spawning sorted, we moved to a gaming element that's more fun. Weapons! Francis showed us how to enable the player to switch between weapons using a fairly abstract system called Arrays. We won't go into too much detail here, as it's fairly complex. What's important is we got it working, so the spider can now pick up weapons and switch between them.

Amusingly, when testing this system with the web shot, the spider picked up the spider web icon and carried it around underneath it. We fixed this problem by switching off the visibility of the web sprite when it's collected. We don't want the spider 'holding' its weapons, as physical objects anyway; they're more like abilities. Also, with the web shot, we switched from the single shot back to the spraying mode, which makes more sense with the larger number of enemies on screen.

As for new weapons, we liked the idea of using an enemy's abilities against them, and currently our only enemy attack is the wasp's sting explosion when it dies, so we then created the Sting Shotgun. The original plan was to make it a machine gun, but we already had a spray weapon in the form of the web shot, so we decided to create a weapon that was single shot, but felt more powerful than the web attack.

The most difficult aspect of getting this weapon to function was creating an appropriate spread effect for the stings. Initially, we tried adapting the explosion code for the wasp, but our efforts didn't work. In the end, the solution was to repeat the projectile code a set number of times, giving each individual sting a random range of 60 degrees. We also increased the speed of the projectiles and the force of the kick, to make the weapon feel deadlier and more powerful.



How our correct boss-spawning code looked, before we changed it to a randomised spawn

Not content with creating one new weapon, we began work on another, far more ambitious one – the web grenade. The idea behind this weapon was that it would fire a grenade a certain distance from the player and then explode into white fragments. Any enemy that moved over the fragments would get stuck, enabling the spider to eat it.

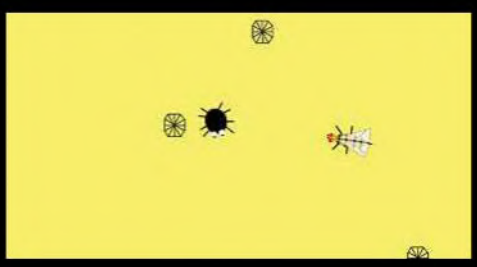
But as a compromise to its power, we wanted the web grenade to have a charge-up period, with the spider spinning the web grenade in front of it before releasing it.

At the time, this new weapon idea seemed doable. We knew how to make objects grow, shoot and explode, so the web grenade was ostensibly a culmination of all we'd learned about game making so far. Of course, in practice, making the web grenade proved much more complex than we anticipated.

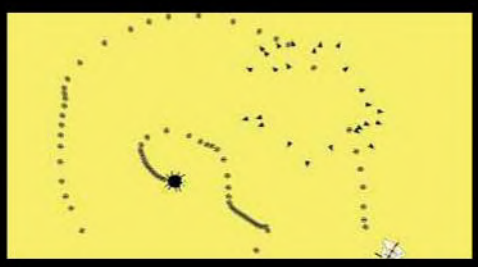
We created a nice new sprite for the sticky ball of web, but getting it to grow correctly proved very difficult. We created a weird cone effect that makes the spider look like it's shooting a kind of death ray, and an amorphous blob that looks a little like a comet with a tail.

We also haven't yet worked out how to prevent a sprite from growing once it reaches a certain point, so at the moment the web grenade just keeps getting bigger.

Next month, we'll push forwards as much as we can, hopefully expanding our spider's arsenal and the threats it needs to overcome, while also possibly enabling our enemies to shoot back, rather than simply killing us upon collision. CPC



Spider vs Wasp, a battle for the ages



The spider's web spray makes its spectacular return

BUILD A MINI APU PC FOR £486 INC VAT

There's no need to waste space on expansion cards and huge motherboards if you just want a PC that can also cope with media playback and light gaming. Antony Leather explores the realms of AMD's APUs and builds a tiny, affordable APU rig

An AMD APU of some description has been featured on our Elite list ever since the A8-3850 was released back in 2011. They're not amazingly powerful, but they offer enough performance for general desktop use, media playback and a bit of gaming on the surprisingly capable integrated graphics.

Of course, with no need for a discrete GPU, there's plenty of scope for building very small systems too, yet so much of the time we see full-sized or micro-ATX APU rigs, wasting needless space. As such, we decided to set about building a super-tiny APU system that you could easily put under your TV.

Our mini APU rig is based on AMD's new A10-7850K (see p22), an SFX PSU plus SilverStone's brand-new FTZ01 case, which is less than half the size of a BitFenix Prodigy mini-ITX chassis. We've also thrown an all-in-one liquid cooler, 8GB of 2,400MHz memory and an SSD into this nifty liquid-cooled mini PC, and it still costs less than £500 inc VAT.

The best hardware for an APU system

The most important aspect of AMD's top-flight APUs is dealing with the heat they produce, especially once they're overclocked. With a TDP of 95W, many low-profile air coolers can't cope. Indeed, AMD has even bundled a quad-heatpipe cooler with a copper baseplate made by Cooler Master with the A10-7870K – a far more potent beast than the solid aluminium heatsink that ships with the FX-6300, for example.

The A10-7870K sports a quad-heatpipe cooler with a copper baseplate made by Cooler Master, while the FX-6300 only has a simple, aluminium cooler

Under light to medium loads, most coolers that state TDP limits of 100W or more should be okay, but if you're thinking of running Folding@home, or any other software that's likely to push the chip to its limits, you'll need more cooling power, especially in a small, cramped case. With all-in-one liquid coolers now retailing for less than £40, they offer a great option for providing ample cooling in height-restricted cases, as you can shove the radiator in a 120mm fan mount, while the combined pump and waterblock usually measure less than 1in high – ideal for use in slim cases.

You also want to keep noise to a minimum, and an all-in-one liquid cooler is your best option in this respect too; in a small case, the only alternative for cooling a top-end APU is a high-RPM low-profile, air-cooler. Admittedly, some all-in-one liquid cooler pumps are noisy, but no more than a whiny fan, and you'll get better cooling too . All in-one liquid coolers have another benefit too, which is that you usually don't need an additional case fan in systems such as the one we're building. Just mount the radiator as an exhaust, and it will deal with all the heat from the CPU and GPU portions of the 7870K.

If you're keen on keeping size to a minimum then it's also well worth considering an SFX rather than ATX PSU. SFX PSUs can offer up to 600W in power – more than enough for most systems – and they save a huge amount of space. It isn't until you see an ATX and SFX PSU side by side that you really see the difference. A 300W PSU will offer enough power for our system.

SFX PSUs (right) are significantly smaller than their ATX counterparts (left)

APU SHOPPING LIST

CASE

SilverStone Fortress FTZ01/ £109 inc VAT

SUPPLIER www.scan.co.uk

The case is the most important choice when it comes to building a mini APU system. You'll need enough space for an all-in-one liquid cooler and, to make the whole plan worthwhile, the case needs to be small too. Cube cases such as Cooler Master's Elite 130 are one option, although they're quite bulky. Instead, we opted for SilverStone's new FTZ01. It's more expensive than a mini-ITX cube case, but it has several advantages. Firstly, it looks great, but it's also very thin, thanks to its use of low-profile fans and SFX PSUs.

CPU

AMD A10-7870K/ £105 inc VAT

SUPPLIER www.ebuyer.com

As we've seen in our review this month (see p22), AMD's A10-7850K sports a higher clock speed for the CPU and GPU than the older A10-7850K, yet it costs just £107 inc VAT.

MOTHERBOARD

Gigabyte F2A88XN-WiFi/ £78 inc VAT

SUPPLIER www.cclonline.com

As we're building a small PC, we're using a mini-ITX motherboard. However, even though mini-ITX is the perfect form factor for APUs, there are decidedly few mini-ITX FM2+ motherboards available. We chose Gigabyte's F2A88XM-WiFi as our test subject. It has proper heatsinks for the power circuitry, 802.11ac Wi-Fi support and it costs less than £80. Plus it also has a 16x PCI-E slot if you ever fancy a graphics upgrade.

MEMORY

8GB 2,400MHz Corsair Vengeance/ £48 inc VAT

SUPPLIER www.scan.co.uk

The speed of system memory is vital in an AMD APU system, as it's shared with the GPU. As a result, the faster the memory, the better the performance you'll see in games. We've opted for 8GB of 2,400MHz Corsair Vengeance DDR3 memory, giving us plenty of memory bandwidth, and enough memory capacity for general-purpose computing.

CPU COOLER

Cooler Master Seidon 120V/ £36 inc VAT

SUPPLIER www.scan.co.uk

Our case has room for an all-in-one liquid-cooler, which will help us overclock the APU without it overheating. Our chosen example, Cooler Master's Seidon 120V, also has a half-height 120mm radiator, which makes it ideal for squeezing into tight spaces. It costs just £36 inc VAT too, so it isn't much more expensive than a decent low-profile air cooler.

SSD

256GB Crucial BX100 / £68 inc VAT

SUPPLIER www.ebuyer.com

While you can save money by opting for a hard disk and get more storage in the process, we recommend using an SSD for all but the most budget-limited systems. They're significantly faster, making Windows more responsive, and they make no noise either. We're using a 256GB Crucial's BX100, which costs just £68 inc VAT.

PSU

SilverStone SST-ST30SF / £42 inc VAT

SUPPLIER www.scan.co.uk

SilverStone offers some compelling reasons to use dinky SFX PSUs, and the FTZ01 case is one of them. We've picked the SST-ST30SF, as its 300W rating offers more than enough headroom for our system. It also costs just £42 inc VAT and offers a super-quiet semi-fanless mode at low load levels.

Total: £486 inc VAT

The Intel factor

There are arguments for and against using AMD APUs in small, cheap systems and the landscape looks set to change in the future too. Early online benchmarks for Intel's Broadwell CPUs equipped with its new Iris Pro 6100 on-board graphics appear to leave even the A10-7870K in the dust, with some results showing performance gains of 10-50 per cent in games. There is a small caveat here though. These results were based on Intel's Core i5-5675C, which is currently unavailable in the shops, and also costs £215 inc VAT to preorder – twice the price of the A10-7870K.

However, we've yet to see the makeup of Intel's Broadwell-based Pentium and Core i3 CPUs. Even a cut-back version of the Iris Pro 6100 combined with an £80-£100 Pentium or Core i3 chip could potentially give AMD a serious run for its money, especially given Intel's vastly superior instructions-per-clock and lower power consumption. At the moment, however, AMD's APUs offer the best available balance when it comes to integrated graphics performance.

ADDITIONAL HARDWARE CHOICES

Our system forms the basis of a powerful and well-featured mini PC. However, there are a few other options to consider. The FTZ01 has a slimline optical bay, so if you're likely to use a DVD or Blu-ray drive, you can have one. However, you'll need a slot-loading drive, which are pricier than tray-loading ones. For a slot-loading Blu-ray drive, you're looking at around £60 inc VAT, and you may need a mini-SATA to SATA adaptor too, although these adaptors only cost a few pounds.

You can also consider using a cheaper case. We've opted for one of the thinnest chassis on the market but there are a few other options, even if you want to use an all-in-one liquid cooler. SilverStone's own SG13 costs around a third of the price of the FTZ01 and can also accommodate an all-in-one liquid cooler and an ATX PSU, potentially saving you money on a new SFX PSU as well.

Panasonic UJ265 / **£60** inc VAT

SUPPLIER www.scan.co.uk

SilverStone Sugo SG13 / **£36** inc VAT

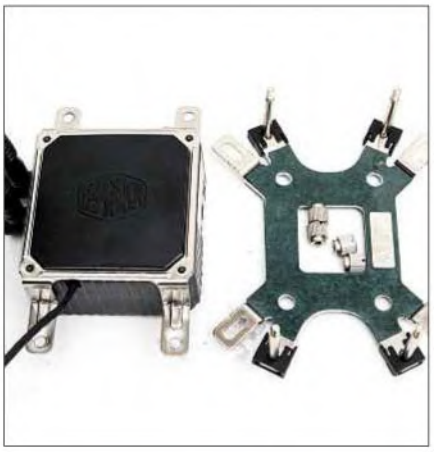
SUPPLIER www.scan.co.uk

BUILDING THE SYSTEM

1 If you're using less powerful hardware than we are, or aren't intending to overclock your system, you can consider removing the intake fan on the side panel. As it's right on the edge of the case, it will add a degree of noise to the equation but its noise is far from intrusive.

2 The next step is to decide where and how to mount the radiator for the Cooler Master Seidon 120V. Start by removing the large plastic section that houses the angled PCI-E riser card and hard disk mounts. There are screws on either side of the case.

3 Decide which way around the radiator should sit, so it puts as little pressure as possible on the tubes and pump. Its position will depend on your motherboard, so place your board in the case too. We found it best to mount the radiator in the furthest fan mount from the motherboard, with the tubes in the middle of the case.



4 The Seidon 120V is pretty easy to install, and uses a backplate and mounting ring that sits on the pump section. Construct the backplate using the AMD fittings, making sure the pins go through the plate from the right side. As the backplate touches the motherboard, there should be adhesive tape between them.

5 You'll need to remove the AMD socket mechanism in order to fit the cooler. There are two screws in each of the plastic mounts, and removing these screws allows you to detach the mounts and backplate. Keep these parts in a safe place, as you'll need them if you ever need to sell your board or return it for repair.

6 Install your APU and apply the included thermal paste to the heatspreader. Double-check which way around you need to mount the cooler in order to put the least stress on the tubes, and you can then mount the cooler using the four pins included in the mounting kit.

7 Fit the rear I/O shield and motherboard in the case. Install the CPU cooler's fan in the motherboard fan header labelled 'CPU'. If you're using the case fan instead, you'll need to use the two-way fan adaptor included in the case box in order to power it and the pump at the same time. The case fan header is located next to the rear I/O panel.

8 Remove the PSU housing, which is located to the side of the motherboard. The FTZ01 uses a PSU extension cable to the rear of the case, as the PSU is essentially located at the front. Put the PSU into its mount, making sure you've turned it on – otherwise you'll have to remove it again, which is extremely annoying.

9 Our SSD has its own mount on top of the graphics card shroud. Remove the shroud before installing the SSD, though, as you'll need to prop up the SSD so the screws can reach the threads and lock it in place.

10 If you decided to use a slimline optical drive, now is the time to install it. These drives use tiny screws, which are included with the SilverStone FTZ01's accessory kit.

11 Now you can go ahead and install the PSU and SATA cables. Despite its size, there are plenty of places to tuck cables out of sight, so spend some time cable-tidying to improve airflow.

12 The FTZ01 includes stands for vertical orientation or rubber feet if you want to mount it horizontally. These stands are essential if you're using an all-in-one liquid cooler, as the fan exhaust vent will otherwise be blocked.

Overclocking

With our all-in-one liquid cooler, there's plenty of room for overclocking the A10-7870K. As usual, don't take our settings as gospel – each APU is different and has its own limits. The 7870K's vcore is set quite high as standard, so there's little room for increasing it. On the plus side, you should be able to reach a decent everyday overclock without even touching the vcore.

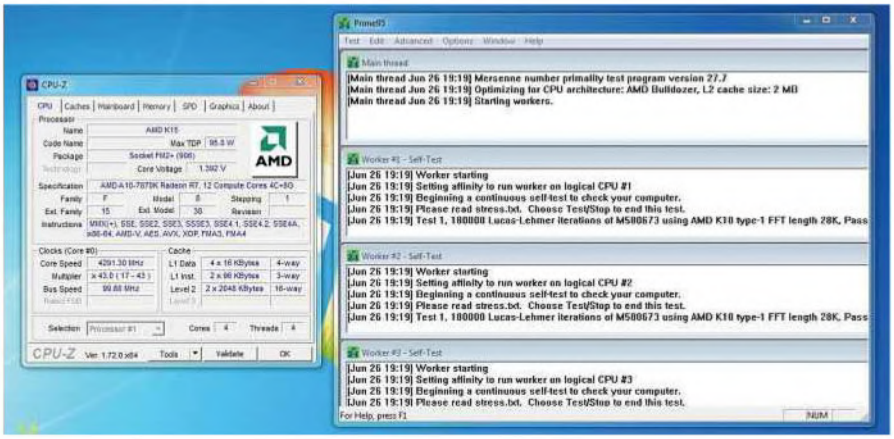
The 7870K's Turbo frequency is 4.1GHz, so aim for at least 4.3GHz plus a bump in the GPU core clock. You'll need to make sure your memory is set to the right frequency and timings though.

In our review of the A10-7870K, we hit 4.6GHz before thermals became an issue, so we're looking to achieve at least 4.3GHz, which is a 200MHz bump over the maximum Turbo frequency and 400MHz faster than the base frequency. Head into the EFI and make sure your memory frequency and timings are set correctly according to the specification. We've also increased the PWM-to-temperature ratio of the CPU fan so it can spin up with heavy loads if needs be.

The same section provides access to the CPU multiplier – raise this setting to 43 for a frequency of 4.3GHz, then save and exit. Once you've installed Windows and your hardware drivers, use Prime95's smallfft test (**http://files.extremeoverclocking.com**) to stress the CPU, and check the temperatures for at least ten minutes using HWmonitor (**www.cpuid.com**). Grab CPU-Z from the same website too, which tells you the CPU frequency. AMD's APUs can throttle under certain conditions, usually if the GPU is also under heavy load, but also if they get too hot, so keep an eye on the clock speed.

If all is okay at 4.3GHz, continue to ramp up the frequency. It's best to stop when the CPU temperature hits around 85°C under full load. We also found the default voltage was pretty overzealous. Our final clock speed of 4.3GHz meant we could reduce the vcore to 1.43V. Once you've found your limit, turn your attention to the GPU.

If gaming is important to you, then overclock the GPU first as you may get a slightly higher frequency – we settled on a GPU clock of 900MHz. Combined with 2,400MHz memory, this total overclock saw some welcome increases in our benchmarks, with a 4fps increase to the minimum frame rate in BioShock Infinite at Low settings, and the image editing test score rising by nearly 1,400 points. **CPC**



Use Prime95's smallfft test to load the CPU, and monitor the frequency with CPU-Z to see if it's throttling

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Box Limited recommends Windows 8.1

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WHAT YOU NEED TO RUN

The Witcher 3 looks amazing, but it also has a tendency to beat graphics hardware into a silicon pulp. Ben Hardwidge runs the new fantasy epic on a number of GPUs, at three resolutions, to find out what you need to run it

The Witcher 3 is undoubtedly a stunning achievement. It takes on Bethesda at its own game, and smashes The Elder Scrolls in its orcy face with a fistful of Aard. Skyrim may have had a glorious open world but, even at the time, the default, unmodded graphics were a bit on the lacklustre side, partly because it also had to run on the Xbox 360 and PlayStation 3. Conversely, while The Witcher 3 might be available on consoles, there's little doubt that the PC version is the graphical flagship.

It's based on CD Projekt's latest REDengine 3, which was specifically designed to enable large-scale open worlds. Exploring the engine in any depth is beyond the scope of this performance analysis feature, but it's a stunning technical achievement in its own right.

For a start, its need for precision means it requires a 64-bit version of Windows and a 64-bit CPU. It also supports a whole load of graphical goodies, from improved facial animations to gorgeous HDR lighting effects, as well as volumetric and particle effects, enabling realistic reproduction of clouds, fog

Our benchmark features a wide variety of scenery, including foliage, water and human settlements

and smoke. Plus there's support for very high-resolution textures, so objects don't look distractingly blocky when you get close to them.

In short, The Witcher 3 looks incredible. If you don't fancy getting involved in any combat, you can happily just ride around the huge open world, marvelling at the sunsets and beautiful scenery, while listening to the ramblings of local villagers. All of this eye candy comes at a price, though, which could well be the price of a brand-new graphics card. To find out what graphics hardware you need to run it, we first set about developing our own benchmark.

Our benchmark

The Witcher 3 doesn't have a built-in benchmark, so we set up a manual, one-minute playthrough, which is not only reliably repeatable, but also features a variety of scenery and non-player characters. Our benchmark starts on horseback in the Lilac and Gooseberries quest, where Geralt follows Vesimir on the road to White Orchard, crossing a river and lots of foliage before reaching a small village. We then get off the horse and walk through the village, past several NPCs and buildings, until the 60-minute FRAPS timer stops.

The benchmark doesn't feature any combat, as we found it makes the benchmark less reliably repeatable, but it does give you a very good idea of the graphics hardware you need to render the high-resolution textures and ride around the beautiful open world.

Most of the cards tested were reference designs, although a few cards were pre-overclocked versions. The non-reference cards used are as follows: an MSI GTX 960 Gaming 2G, an Asus DirectCU Mini GeForce GTX 970 and an EVGA SC GTX 770. As such, you can assume that the quoted results for the GTX 770, 960 and 970 cards may be a little higher than the results you'll get from a stock-speed reference card, although the differences will be small.

Detail presets

The advanced graphics options in The Witcher 3 offer several tweakable settings, but it can all be simplified into Low, Medium, High and Ultra presets. In terms of detail, there's a very noticeable difference between Low and Medium, with the former mode having blurry textures with smooth edges and fuzzy shadows.

Moving up to Medium gets you a significant improvement in visual quality, with sharper detail on textures and sharper shadows. Going up to High again gets you noticeably sharper detail, which you can easily spot on textures showing wood grain, or straw thatch. However, stepping up to Ultra doesn't improve texture detail significantly over the High setting – you have to really zoom in close to a texture to spot any difference – so you won't notice it when you're playing the game.

The presets change other aspects in addition to texture detail, of course, including the number of NPCs, lighting effects and so on. However, in our tests, we found it hard to spot the

At Low detail, the straw thatch and wood grain looks blurry and flat, with fuzzy edges and shadows. Moving up to Medium reveals more detail in the straw and wood grain, while the High setting sharpens the image further

difference between High and Ultra settings and, for this reason, we've settled on High settings as the default for our benchmark, although we've also benchmarked the game on Ultra settings for the purpose of this feature.

HairWorks

In addition to the usual graphical tweaks, The Witcher 3 also supports Nvidia's HairWorks technology. As its name suggests, HairWorks makes hair and fur look more realistic, so that it behaves in a dynamic way, rather than looking flat and static.

Instead of using the usual method of making hair from strips of polygons and transparent textures, HairWorks uses tessellation and dynamic volume to effectively create thousands of individual, dynamic hair strands on characters, which respond realistically to the character's movement, as well as lighting.

It works too – you don't really notice it so much on human characters unless you get close to them, but HairWorks makes a significant difference to animal fur, as you can see in these horse screenshots.

Without HairWorks, the horsehair looks flat and unrealistic, with a few curls here and there, but with HairWorks enabled, you suddenly see individual strands of hair that move dynamically. HairWorks is enabled on higher presets, but not on lower presets by default, although you can enable it on every character, or just Geralt, at any preset if you adjust the setting yourself.

Performance

The good news is that every card we tested, from the Radeon R9 270X upwards, was able to run The Witcher 3 at High settings at 1080p, as long as HairWorks is disabled. No card dropped below 30fps at these settings, while a GTX 970 will happily play the game without sinking below 60fps.

Enabling HairWorks results in a performance hit, though, and one that's more pronounced on AMD hardware than Nvidia GPUs. Simply enabling HairWorks caused our Radeon R9 290X's minimum frame rate to fall from 54fps to 29fps, a drop of 46 per cent.

Comparatively, a GeForce GTX 980 Ti dropped from 78fps to 61fps, a drop of just 22 per cent. Of course, these cards sit in very different price leagues, and their overall performance isn't directly comparable, but it's clear that HairWorks currently favours Nvidia hardware.

While sticking at 1080p, we also benchmarked the game at the Ultra preset, again with HairWorks on and off. With HairWorks off, the Radeon R9 290X managed a very respectable minimum frame rate of 41fps, a drop of 21 per cent. Likewise, the GeForce GTX 980 Ti's frame rate also only dropped by 18 per cent.

Again, the Nvidia hardware copes better with the change to Ultra mode, but the difference is only slight. Enabling HairWorks in Ultra mode

RECOMMENDED MINIMUM HARDWARE

- **1,920 x 1,080, High settings, HairWorks Off**
  AMD Radeon R9 270X
  Nvidia GeForce GTX 770
- **1,920 x 1,080, High settings, HairWorks On**
  Nvidia GeForce GTX 960
- **2,560 x 1,440, High settings, HairWorks Off**
  AMD Radeon R9 290
  Nvidia GeForce GTX 970
- **2,560 x 1,440, High settings, HairWorks On**
  Nvidia GeForce GTX 970
- **3,840 x 2,160, High settings, HairWorks Off**
  AMD Radeon R9 Fury X
  Nvidia GeForce GTX 980 Ti

really punishes AMD GPUs, though, with the Radeon R9 290X only just sitting on the 25fps minimum border that we consider to be playable.

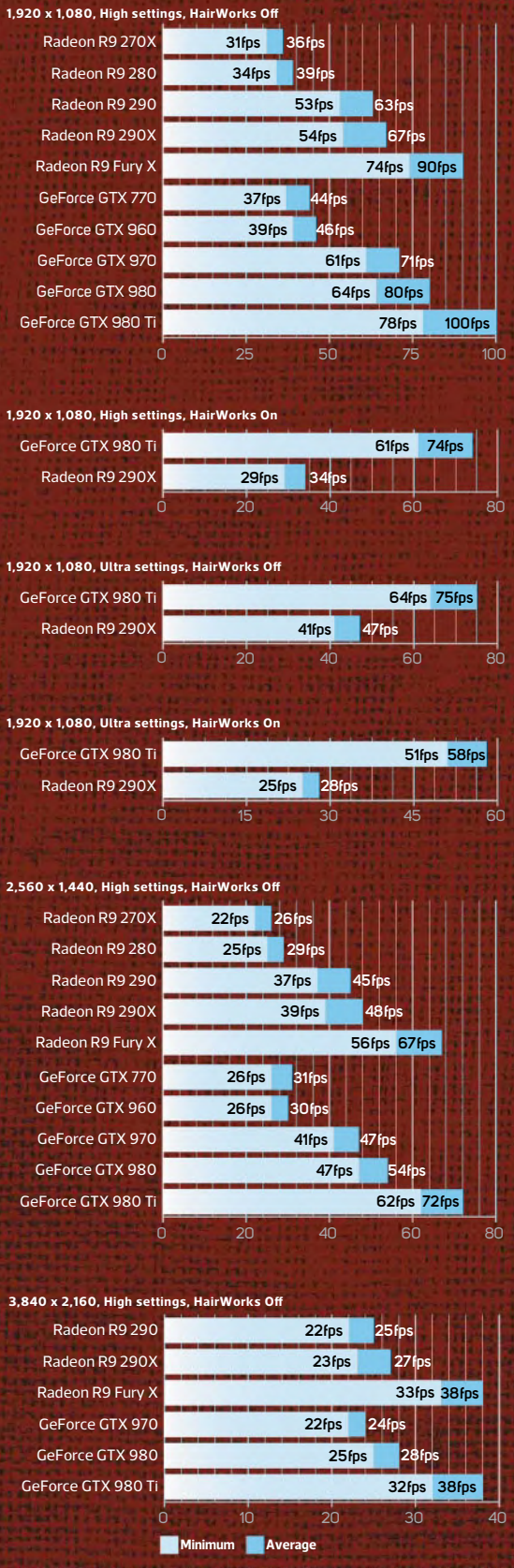
Moving up to 2,560 x 1,440 with HairWorks off presents more of a challenge to cheaper cards than 1080p, with the Radeon R9 270X's 22fps now sitting below the playable threshold. The Radeon R9 280, GeForce GTX 770 and GTX 960 are all in the borderline playable bracket at this resolution, but to be comfortable, you ideally don't want your frame rate to drop below 30fps.

As such, the recommended cards for this resolution are the Radeon R9 290 and GeForce GTX 970, with the latter's minimum of 41fps giving you some headroom to even enable HairWorks at this resolution.

Finally, running the game at 4K presented a very serious challenge to nearly every GPU on test. A GeForce GTX 980 will run the game at High settings, but only just – if you want to stay above the 30fps barrier then only a Radeon R9 Fury X or a GeForce GTX 980 Ti will cope with the workload, with the former having a slight edge as long as you don't enable HairWorks.

Interestingly, in almost every result, the average frame rate is very close to the minimum frame rate, except when running at 1080p at High settings on very high-end cards. This suggests that the game quickly becomes CPU-limited, so you may well find that overclocking your CPU further enables you to squeeze out a couple more frames per second if your GPU is running out of steam. CPC

RESULTS



TEST KIT

Intel Core i5-3570K overclocked to 4.2GHz, Asus Maximus V Extreme motherboard, 8GB (2 x 4GB) Corsair Dominator 2,400MHz DDR3 RAM, 256GB Samsung SSD 840 Pro, LEPA G1600 1,600W PSU, Windows 7 64-bit, Nvidia GeForce driver 353.06, AMD Catalyst 15.5 Beta

GARETH HALFACREE'S

Hobby tech

The latest tips, tricks and news in the world of computer hobbyism, from Raspberry Pi, Arduino and Android to retro computing

REVIEW
4tronix Agobo

Gareth Davies, of UK educational electronics specialist 4tronix, was kind enough to send me an early version of his Pi2Go-Lite Raspberry Pi-powered robotics kit last year, which I reviewed positively in Issue 135. Now Davies is back with a new kit, dubbed the Agobo, designed for minimal cost and footprint.

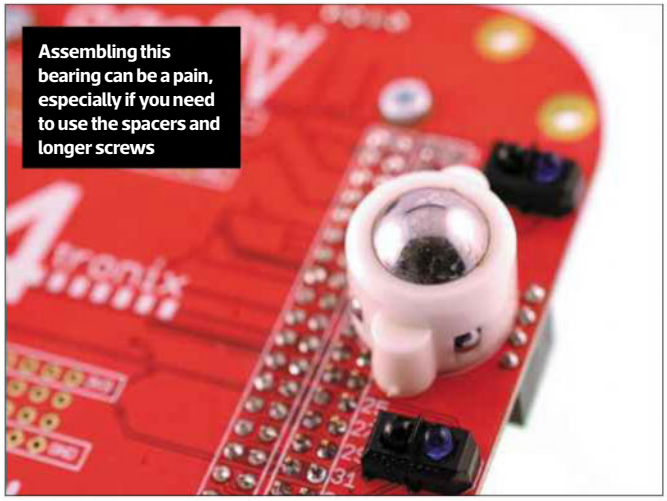
Unpacking the Agobo kit, you first notice that it's a lot smaller and simpler than any Pi2Go model. There's a single circuitboard, which is already assembled – requiring none of the soldering of the Pi2Go-Lite. That's a positive in terms of getting started quickly, but could be seen as an educational negative; thankfully, Davies has no plans to retire the Pi2Go family, though, so buyers still have a choice. There's another reason to keep both families around too: the small-footprint Agobo is designed exclusively for the ultra-compact and low-power Raspberry Pi Model A+, and will work with no other model.

The circuitboard may be pre-populated, but there's still some assembly required – and it's of the fiddly type that requires adult supervision. Two thin back wheels need to be slotted onto geared motors at the rear of the robot, while the front uses a ball-bearing assembly. This part needs smaller bearings

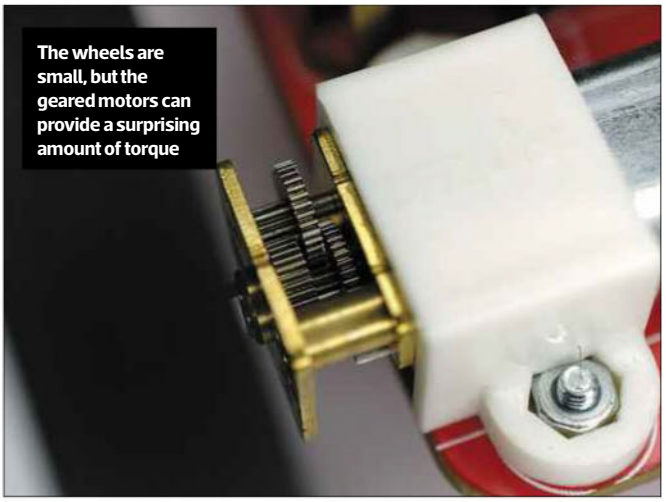
The 4tronix Agobo robot kit is simpler and smaller than the Pi2Go-Lite

balanced on top of a larger bearing, a lid put on the lot and then all the bits squeeze together while it's screwed to the PCB. It's a tricky enough process using the standard-length screws, but if you want to use the extended screws and spacers – designed to make use of the replicated general-purpose input-output (GPIO) header easier, or when using the optional PlusPlate prototyping board with the robot kit – be prepared for some serious frustration.

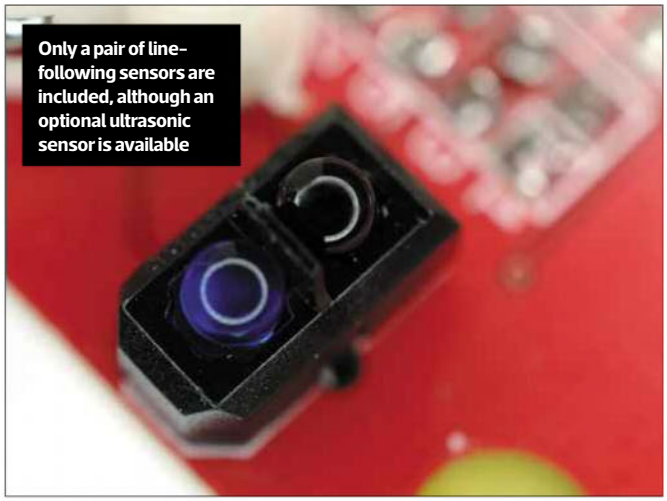
Thankfully, that's by far the hardest part of the process. The remainder includes a clip for the bundled USB-rechargeable battery, leading to longer runtimes and lower running costs than the AA batteries of the Pi2Go range. There's also a set of brass mounting pillars, and the optional but undeniably



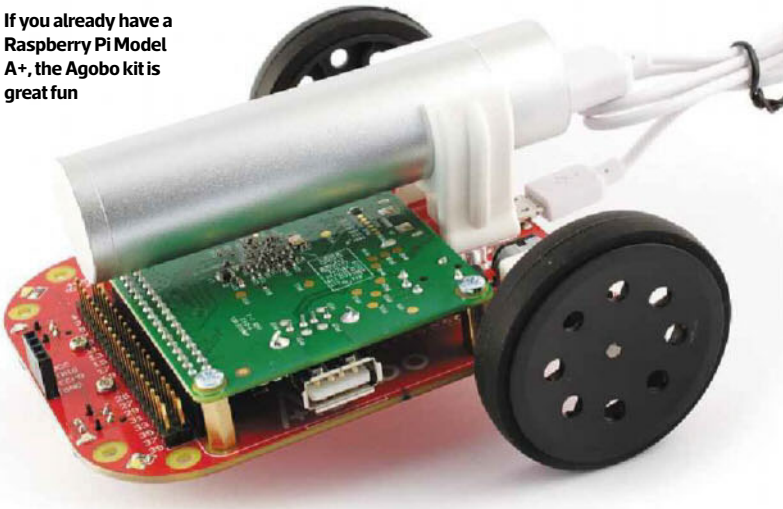
Assembling this bearing can be a pain, especially if you need to use the spacers and longer screws



The wheels are small, but the geared motors can provide a surprising amount of torque



Only a pair of line-following sensors are included, although an optional ultrasonic sensor is available



If you already have a Raspberry Pi Model A+, the Agobo kit is great fun

attractive protective acrylic plate. It should take no longer than a few minutes to fit these remaining parts, and the Raspberry Pi itself fits snugly and securely upside down on a set of female headers.

Davies describes the Agobo as a hackable robot, and that's undeniably true. There's a replicated GPIO header for connecting additional hardware, and the PlusPlate prototyping add-on for creating your own accessories. There's also a breakout serial console port and inter-integrated circuit (I^2C) pins for adding sensors or the optional IP Display dongle, providing a handy way to find the Pi's IP address if you fit a Wi-Fi adaptor.

As supplied, however, the Agobo is pretty basic. The two N20-sized metal-gear motors are surprisingly powerful and individually addressable, as are the two LEDs located at the front of the board. Sensor-wise, however, there's only a pair of line-following sensors; an optional HC-SR04 ultrasonic distance sensor provides capabilities closer to that of the Pi2Go family at additional cost.

The downloadable software – also available to buy on a micro-SD card, pre-flashed and ready to go – provides examples of controlling the robot in both Python and Scratch, making it suitable for almost any age once assembled. That age range includes adults, of course: as with the larger Pi2Go, I took great joy in chasing the cat around the living room with the Agobo. Naturally, full source code is provided – hard to avoid in an interpreted language such as Python – giving even beginner roboticists and programmers a chance to see how to make the Agobo perform simple tasks.

> Davies describes the Agobo as a hackable robot, and that's undeniably true

The big selling point of the Agobo, though, is pricing. Where the Pi2Go-Lite costs £43 inc VAT and the full-fat Pi2Go £60, the Agobo costs £36 inc VAT, although this price increases to £38 if you add the same ultrasonic distance sensor that's supplied with the Pi2Go-Lite.

Add £19 inc VAT for a Raspberry Pi Model A+, and you can have a fully functional line-following programmable robot for the pleasingly repetitive price of £54.54 inc VAT. That isn't a lot of cash, and while it would be undoubtedly cheaper to pick up some wheels, motors and an H-bridge controller, you would struggle to build a robot that was anywhere near as neat and tidy as the Agobo yourself – even if the bundled USB cable for the battery is laughably long, sticking out from the back of the robot like a white mouse's tail.

That's being picky though. In general, the Agobo has a well thought-out design, and I applaud the use of the rechargeable USB battery – a lipstick type that's easily purchasable at low cost from eBay, giving you the option of owning multiple spares for swapping out at will. If you specifically need Model A+ support or a small footprint, it's an obvious choice; if you have a bit more slack in your budget, though, you'll be better off buying the more feature-packed Pi2Go-Lite and a pack of rechargeable AA batteries.

The Agobo and all its accessories are available direct from the designer at **www.4tronix.co.uk**

EVENT DIARY

Halifax Mini Maker Faire

If there's an appropriate label to describe maker culture – aside from 'curious,' 'handy,' 'thrifty' and 'cutting-edge' – it's 'social'. The stereotype of the lone geek in their bedroom or basement, tinkering away with crazy projects has given way to a group of geeks in joint facilities, tinkering away with projects that have become no less innovative as a result of this shared involvement. At no time is this social element more obvious than at maker-themed events, such as the Halifax Mini Maker Faire I attended this month.

Torben Steeg spent the weekend teaching people how to solder, including five-year-old Finlay

Located right next to the station at Eureka, the national children's museum, the two-day event is a cut-down, community-based variant on the full-sized Maker Faires run by Maker Media throughout the world. It's small and intimate in comparison, but it's still a great event to add to your schedule if you're interested in the culture.

With free entry for Eureka ticket-holders, the Halifax Mini Maker Faire was always going to be well attended

'I think it's awesome. This is the biggest show-and-tell you could possibly imagine,' enthused Bob Stone, representing York Hackspace, of Spacehack fame (see Issue 140, p94). 'There's a social aspect, in that we meet our buddies – the maker community is essentially held together by the Internet and Maker Faires. We come to these events to show what we've built, to encourage people to learn how to make things themselves, to meet other like-minded makers from other groups and to compete for the glory of having the most awesome thing. Which, of course, we usually win with Spacehack!'

For me, too, the event afforded an opportunity to catch up with friends from the local area. John Stockill and the crew from Leeds Hackspace had the table next to Stone and his gang. 'We're showing off Joe [Corcoran]'s powered angle-poise lamp, which is currently being very shy, and avoiding looking at people, but it's supposed to track faces and watch people as they walk past,' Stockill laughed, sharing the usual tale of last-minute technical glitches with which anyone who has ever exhibited at an event will sympathise.

There were plenty of attendees I hadn't previously met, of course. Janine Kirby, of Sheffield Hardware Hackers & Makers, walked me through her team's stand in the make-believe Post Office located in the museum's main hall. 'We're branching out a bit more,' she explained. 'We've got woodworking, and one of our members has

York Hackspace's Spacehack was as popular as ever, even drawing in museum staff from their assigned duties

A face-tracking lamp, created by Leeds Hackspace's Joe Corcoran, developed stage fright just before the doors opened

Giles Grover's Small Machines certainly caught my attention, and I left the show £15 lighter as a result

John 'Toy Hacker' Waltham was well-placed to amaze younger visitors with his upcycled creations

made a Deek Chair, which is a deck chair for geeks. We've also got egg incubators on display, and a nerve cell that will have flashing LEDs, showing the impulses that come down to the muscles to make us move. We have a mood light with LEDs changing through multiple different colours too. On the other side of the table we've got a weather station, and a kite-cam, as well as a Raspberry Pi set up for Scratch to get people into coding.'

Others were at the event to show off their products to potential purchasers, such as Giles Grover of Small Machines. 'They're laser-cut, wooden construction kits,' he told me. 'They're called Small Machines because each kit in the range is based on a real-world hydraulic-powered machine. My idea was to design and make contemporary wooden toys that didn't rely on batteries and electronics, so I'm using syringes, tubing and tap water to replicate hydraulic movement.' The pitch was so convincing that I admit to parting with my hard-earned cash to buy a replica digging arm to build with my daughter.

Other exhibitors, located in the old station house, were even more hands-on. When I found Torben Steeg, he was halfway through teaching a five-year-old boy called Finlay to solder an electronic badge.

'Everything these days has electronics inside it. So, if you want to have control over the stuff that you own, if you want to be able to fix it or make your own stuff, you need to know your electronics,' the former teacher explained of his desire to get people – kids and adults – to pick up the skill.

'It's a five-minute learning job, it's dead easy, certainly. I mean, you just saw a five-year-old doing it. I helped him, but he can manage it – and certainly eight-year-olds can just do it themselves.'

Sheffield Hardware Hackers & Makers brought plenty to show, including an LED-equipped cuddly nerve

'I think this is the first thing he has actually wanted a go on,' says Finlay's mother, Francesca, 'which I think says something, because it's a little more dangerous!'

The beauty of the setting, of course, is that it attracted a crowd with little previous exposure to maker culture. 'We've not actually been before,' attendee Nick told me, while keeping an eye on his daughter Annabelle and baby son Raphael as they watched self-described 'toy hacker' John Waltham's creations cavort and spin. 'We're members of the Eureka membership club, but this is the first time we've combined the experience with such a fair, you know, and it's been good.'

Plans are already unfolding for next year's reprise. If you're interested in attending it, head to **http://makerfairehalifax.com** to find out more information.

NEWS IN BRIEF

Arduino LLC taps Adafruit for manufacturing

In the continuing legal battle between Arduino LLC and its former manufacturing partner Arduino Srl., previously known as Smart Projects, it has been announced that future Arduino boards are to be produced – in the USA at least – by Adafruit. The move comes with a new brand, sidestepping the trademark battle – boards made by Adafruit for Arduino will be marketed as Genuino, an entirely new name that will replace Arduino, starting on the current Leonardo and Uno boards. It isn't yet clear how the move will affect international availability of official boards.

VINTAGE

Acorn x86 Card

In the process of clearing out the bulk of my vintage computing collection, I came across an accessory for one of my Acorn computers that I'd forgotten buying, and never got around to installing: the Acorn RiscPC x86 Card.

Prior to Windows, the x86 PC had been largely ignored by mainstream consumers. Expensive and lacking in the graphical and audio capabilities of rival machines such as the Acorn Archimedes and Commodore Amiga, x86 PCs were by and large the preserve of companies and other well-heeled enterprises. The development of IBM-compatible BIOSes by companies such as Compaq, leading to the release of lower-cost and higher-performance clone machines, helped to drive down cost; Windows helped boost popularity.

Windows 95, in particular, was a watershed moment for Microsoft. Built from the ground up with multimedia in mind – back when the Multimedia PC logo was still a useful sign when browsing for a new machine – the operating system became the de facto standard for IBM compatibles.

These days, 'IBM compatible' means pretty much any PC. ARM processors may have sewn up the embedded space and even made inroads into low-power laptops, but the x86 instruction set – and AMD and Intel's 64-bit extensions thereof – rules mainstream computing. Even buying an Apple computer now gets you a PC fully capable of running Windows; Apple even provides software for doing so in a dual-boot configuration.

The Acorn x86 Card gave the ARM-based RiscPC the ability to run Windows for the first time

This custom chip was developed by Acorn, Aleph One and serial interface giant FTDI

When your PC is x86, running Windows is easy; when it uses another instruction set, it's damn near impossible. PC emulation packages, ancient precursors to DOSbox and QEMU, worked tolerably for DOS-based packages and even Windows 3.1, but were too inefficient to handle Windows 95 with reasonable performance.

The answer was to use an add-on board containing the guts of an IBM-compatible. The Amiga had 'bridgeboards', while the RiscPC had the Acorn x86 card. My second-generation model, purchased as new-old-stock (NOS) from a well-known auction site years ago, has a 100MHz 486 DX4 processor, interestingly built by Texas Instruments rather than AMD or Intel. This CPU is tied into the system by a custom chip constructed to Acorn's requirements by Aleph One and FTDI.

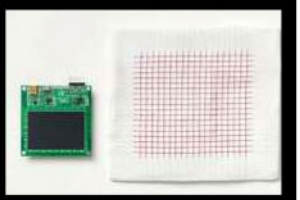
Inserted into a RiscPC's backplane with the drivers installed, the 486 acts as a co-processor with a difference: it's invisible to native applications, appearing only to IBM-compatible applications run through its interface – to which, naturally, the RiscPC's ARM processor is equally invisible. Memory is shared: a chunk of system RAM is reserved for the 486, while the rest is available to the native system. As such, you don't need to double up on memory modules, an important consideration given the price of memory in the 1990s.

Unlike software emulation, the x86 Card offered native performance – minus a little overhead on memory access – and near-total compatibility with any software, including Windows 95. For anyone who had already invested in the Acorn ecosystem, these add-ons offered compatibility with the growing Microsoft majority at a far lower cost than buying an entirely new system.

Sadly, of course, it was short-lived. By the time this example was released in 1995, the RiscPC was on its last legs; its successor, the bright yellow Acorn Phoebe, would be cancelled before launch in late 1998, although under Castle Technology, RiscPCs would be produced until 2003. The x86 architecture, and Windows, had won, and while the computing market would become less varied and colourful as a result, it put cross-compatibility problems, and the concept of a PC card or bridgeboard, in the past. CPC

NEWS IN BRIEF

Google launches Jacquard wearable project



Google is expanding its wearable computing initiatives, currently based around Android Wear and Google Glass, with the launch of computing devices designed for electronic textiles. Dubbed Project Jacquard, after the programmable loom, the launch includes ultra-compact, button-sized computing devices that can be networked using fibres claimed to be indistinguishable from standard fabrics, but using ultra-thin metallic alloys to conduct electricity. While the company is showing off the technology now, it hasn't indicated when (or if) it plans to bring the concept to market.

Gareth Halfacree is the news reporter at www.bit-tech.net, and a keen computer hobbyist who likes to tinker with technology. @ghalfacree

ANTONY LEATHER'S

Customised PC

Case mods, tools, techniques, water-cooling gear and everything to do with PC modding

Hands-on with Cablemod sleeved cables

There are quite a few ways to get custom-coloured, sleeved cables for your PSU now. Many companies, such as Corsair, offer replacement cable kits in various colours, which replace the stock cables supplied with their modular PSUs. These cables are straight replacements and cost around £70 for a full set. Meanwhile, other companies, such as Cablemod, offer the same types of cable kits for PSUs from various manufacturers, and have even gone as far as mixing colours, albeit just with a mix of black and red or black and white.

Of course, another method is to sleeve your PSU's existing cables yourself. However, removing the cables from their connectors, dealing with often fiddly cable removal tools, heatshrink and cable braid is a hugely time-consuming and often expensive process. Thankfully, Cablemod has recently introduced a range of products that bridge the gap between totally custom sleeving and off-the-shelf pre-braided cable kits.

The company now sells ModFlex sleeved cables, which come with connectors at each end, enabling you to mix and match any of its colours within a single plug. It offers female/male connector packs so you can create your own extension cables,

Cablemod's ModFlex cables have connectors at each end, so you can mix colours within a single plug

although you'll then be left with the stock modular or captive cables from your PSU to hide away as well. However, it's also fairly straightforward to remove the cables from a stock modular connector on the end that connects to the PSU, enabling you to completely replace the old cables with the new ones.

You'll need a cable-modding kit for this job but, as the cables can be bought in different lengths and come with the connector pins already attached, it's certainly a lot easier than doing the whole lot yourself.

Four-packs of cables in 20cm, 40cm and 60cm lengths cost between £3 and £4, so wiring up a 24-pin ATX connector will cost up to £26 alone. Overall, though, the process of wiring up a whole PSU doesn't end up being more expensive than a pre-sleeved kit, and it gives you the advantage of being able to customise the colours to match your case too. The quality of the cables is excellent, and it would be a simple job to add some coloured heatshrink to the ends as well.

Creating an 8-pin EPS 12V extension took about five minutes, so you could kit out an entire PSU in under an hour. The downside is that there's currently no way to use these cables with SATA or Molex plugs, so the idea is that you hide every plug, except the PCI-E, 8-pin EPS 12V and 24-pin ATX connectors, which isn't a tough job in most cases these days. I spoke to Cablemods about this current limitation, and the company said it had no plans to introduce customisable SATA and Molex cables, as it's too tricky for the end user to install them. However, Cablemod will be offering pre-braided SATA and Molex kits separately, so you can buy cables that will match or nearly match your customised ones. Cablemod cables can be bought from **www.overclockers.co.uk**

Alphacool pre-bent metal tubing

Last month I spent many hours working on a How to guide about advanced methods with rigid tubing (see Issue 143, p102), which looked at both acrylic and metal tubing. You can either connect acrylic tubing in straight

Alphacool's pre-bent tubing comes with a 10cm short side and a 30cm long side

lines or, for a really nifty look, you can use a heat gun to bend it to the required shape. Working with metal tubing is slightly trickier though. You can use soft copper tubing, which can be bent to shape using a pipe bender or, alternatively, Alphacool offers straight, plated brass tubes that come in chrome or dark chrome finishes.

The latter can't be bent, though, as the coatings flake off, which is a shame, as the tubing is otherwise very good-looking and works perfectly with Alphacool's rigid tube fittings. The other problem with these straight tubes, though, is that you have to use dozens of additional fittings to create bends, using several sections of straight tubing. As luck would have it, Alphacool has just released pre-bent tubing that solves this problem.

The tubing currently comes with a short side of 10cm and a long side of 30cm with a 90-degree bend between the two. You can trim either end to the required length, which should eliminate the need for multiple connections in most scenarios, saving you having to buy dozens of fittings to create bends. The tubes cost £12, which is only £2 more than the same length of straight tube, but you'll save over £8 in the cost of fittings in the process, making this pre-bent tubing a no-brainer really.

Modding competitions

We're only halfway through 2015, but three great PC modding competitions have already taken place. The first is bit-tech's Intel NUC case contest, for which five modders' designs for Intel's mini motherboards were selected, with the winners then receiving NUC systems to actually build their designs. Bit-tech revealed the completed projects in early June and they're very impressive indeed. You can see them all at **http://tinyurl.com/intelnucmods**

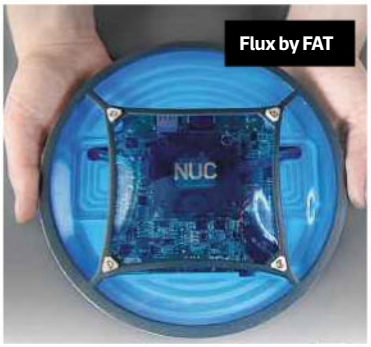
Next up was Cooler Master's Case Mod World Series, where I was lucky enough to be a judge. The money and prizes on offer attracted dozens of entries, many of which were world-class. This competition attracts both new and previously seen projects too, so there's a mix of well-known and fresh talent. Cooler Master had four categories this year, including case mods based on Cooler Master cases, scratch builds, rising star and people's choice.

The Warhammer 40,000-themed Black Templars mod by Modder Crow took the tower mod top spot, while an enormous Tri-Max all-in-one water-cooled PC with a 34in QHD curved monitor claimed the top scratch-build spot. The slightly bizarre dog mech mod Kruper Dog picked up the rising star award, and the people's choice award went to a superb Superman-themed project called Man of Steel, which is certainly one my favourite projects of 2015 as well. You can see all the winning projects at **http://tinyurl.com/cmmodwinners**

Finally, EK Waterblocks has revealed the mods created with the Vulture cases that it recently sent out to modders for tinkering purposes. There are some stunning PCs on display here, from some of the best-known modders from around the world. There are eight entries in all and you can see and vote for them at **http://tinyurl.com/vulturecase** CPC

Man of Steel

EK Vulture build by B-Negative



Flux by FAT

Here's a small sample of some of the superb builds we've seen recently, including NUC cases, such as Flux and Hanging in the Balance, and two builds based on EK's Vulture case

Hanging in the Balance by Mosquito

EK Vulture build by Montymole

Antony Leather is Custom PC's modding editor @antonyleather

How to Polish frosted waterblocks

Want a crystal clear view of your waterblock and coolant? Antony Leather shows you how to polish it

TOTAL PROJECT TIME / 1 HOUR

Waterblock aesthetics have come a long way in recent years, with all manner of different designs available. EK, for example, not only offers solid Acetal plastic waterblocks, but also frosted clear acrylic blocks. These latter blocks have a great-looking smooth finish, but they also only offer a rather obstructed view of the interior.

By polishing the waterblock, however, you can remove this frosting effect quite easily, and the impact is amazing. The acrylic stops being opaque and becomes crystal clear, providing a great view of the waterblock innards, as well as your coloured coolant. Best of all, this cheap job only requires a polishing cloth, wet and dry sandpaper, and some car polish.

TOOLS YOU'LL NEED

2,000-grit wet and dry sandpaper / Halfords

Polishing cloth or Dremel polishing attachment / Most hardware stores

Meguiars Ultimate compound / Halfords

1 / ASSESS WATERBLOCK FOR SUITABILITY

To create the clear finish, you'll first need to check that your waterblock already has the aforementioned frosted clear acrylic finish. If so, the acrylic will provide some sort of view all the way through to the centre of the block.

2 / CHOOSE YOUR TOOLS

To polish the waterblock, you can either use wet and dry sandpaper with abrasive car polish or, if that sounds too much like hard work, you can achieve the same effect with a Dremel and a polishing wheel attachment.

3 / DISMANTLE WATERBLOCK

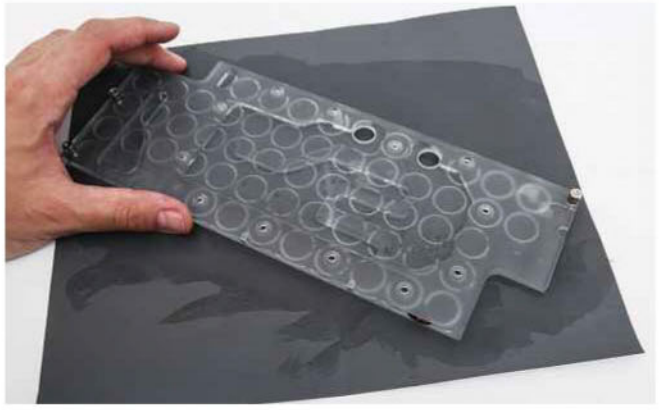
You'll need to work on both sides of the waterblock to clear off the frosting effect from each side to provide a clear finish. As a result, you'll need to remove the acrylic section from the base plate, which is usually an easy job.

4 / REMOVE LOGO

EK's CSQ waterblocks usually have a logo attached, which you'll need to remove in order to make your work easier when sanding the waterblock. Use a scalpel to lift it off the block, but watch your fingers.

5 / USE WET AND DRY SANDPAPER

You'll need to use a very fine-grit sandpaper, such as 2,000-grit, to wear down the existing finish and provide a basis to start polishing. If you use a coarser sandpaper, you'll massively increase the task ahead when polishing.



6 / SAND WATERBLOCK

When sanding the block, you'll remove the frosted finish quite quickly. For smaller sections, such as the coolant channels, tear off a little sandpaper and work at the insides. To check the finish, wash off the debris and allow it to dry. It should feel smooth and slightly glossy.

7 / USE POLISH

You can use any abrasive polish, such as T-Cut, Autosol or our personal favourite, Meguiars Ultimate Compound, which we've used here. Apply this polish to a cloth, or your Dremel attachment, and continue until the acrylic is perfectly see-through across the entire top.

8 / CLEAN BLOCK WITH ALCOHOL OR DETERGENT

To make sure no polish gets into your coolant once you reassemble the block, wash both sides of the block with alcohol or detergent and rub it gently with a cloth. Don't be tempted to scrub it with a scourer, or you may end up scratching it.

9 / DRY AND BUFF TO A SHINE

Place the top section back onto the waterblock base plate, and check that it still fits. You should see a marked difference after polishing, with a clear view of the interior. If you see any parts you've missed, just use the polish again. CPC

How to
Give your case a wood effect

Want to make your HTPC blend in with your lounge furniture? Antony Leather shows you how to wrap it in vinyl to create a wood effect

TOTAL PROJECT TIME / 3-6 HOURS

While sprucing up your case a little with a coat of spray paint looks relatively easy, you don't necessarily want a brightly coloured PC box in your lounge. It can be tricky to achieve a perfect paint job too, and you certainly don't want a messy paint job taking pride of place in your TV cabinet. If you're on a limited budget, you may well have a cheap HTPC case too, which can look pretty drab sitting next to most flatscreen TVs, routers and set-top boxes.

There's a quick and easy way to add some pizzazz to your PC case, though, and small HTPC cases are particularly well suited to this method. Adhesive vinyl comes in a variety of designs, including brushed aluminium and carbon fibre effects, but we're looking at wood vinyl that can turn your PC into a machine that looks like it's been made by a world-class modder. Best of all, it only takes an hour or two, you can do it indoors and the total cost is less than £20.

TOOLS YOU'LL NEED

Adhesive vinyl /
www.ebay.co.uk

Scalpel /
Most hardware stores

1 / CHECK CASE FOR PRACTICALITY

Complicated exteriors with lots of protrusions or angles will complicate your task, so look over your case to gauge how much work will be required. Most HTPC cases are little more than rectangular boxes so they lend themselves well to being covered in vinyl.

2 / MEASURE AREA TO BE COVERED

Before you buy the vinyl, work out the rough surface area required. Vinyl comes in various widths, so being able to cover the whole case in a single sheet eliminates the possibility of ending up with unsightly joins.

3 / DECIDE ON VINYL MATERIAL

There are many vinyl finishes available, including carbon fibre, brushed aluminium and just straight colours. This month we're focusing on wood effects, but there are plenty of wood finishes from which to choose. Just make sure your choice is self-adhesive.

4 / CLEAN CASE

To ensure the vinyl adheres to the case properly, make sure the case is spotlessly clean first. Apply isopropyl alcohol or household polish to the case, and leave it for a few minutes before wiping it clean, in order to ensure there are no leftovers from logo stickers, for example.

5 / DISMANTLE EXTERIOR FITTINGS

You don't want to cover the whole case in one go, or you'll risk parts being punctured if you cover over large gaps. Instead, apply the vinyl to each section of your case separately, removing any panels or fascias before covering them.

6 / CONSIDER DE-RIVETING

If some areas of the case are too large or fiddly to cover, but are riveted together, you can drill out the rivets to make the job easier and look more professional. You can buy replacement rivets and rivet guns fairly cheaply.

7 / OVERLAY VINYL

To easily work out how much vinyl you need, place your case panels on the vinyl and mark them up, allowing enough of an overlap to bend the vinyl over the edges.

8 / TRIM TO SIZE

Vinyl is easy to cut, so you can just use scissors or a scalpel to trim it to size. Again, remember to leave enough of an overlap for you to stick the vinyl to the inside of the panel.

9 / REMOVE AIR BUBBLES

Vinyl is usually easy to apply, and air bubbles shouldn't be a problem. However, bubbles do sometimes appear, especially on uneven surfaces. You can use a credit card to push them to the end of the panel, or to push them out while applying the vinyl.

10 / FOLD OVER EDGES

Fold the vinyl over the edges in straight lines. This job will involve cutting strips off some of the edges so they can bend over various features on the panel, and to bend over areas that have different heights.

11 / BEND AROUND EDGES

You can use the same technique to apply the vinyl around corners and edges. Pay particular attention to making sure the vinyl is firmly stuck down. Otherwise, the vinyl can lift over time, and end up looking unsightly.

12 / APPLY TO FASCIAS

It can be trickier to deal with fascias, as they often have varying angles and spaces for buttons. Cover the whole area first.

13 / CUT OUT HOLES FOR BUTTONS

Most fascias will just need holes for buttons and an optical drive to be cut out of the vinyl. If you press the vinyl into the holes, you'll get a clear outline, allowing you to accurately cut them out for a neat finish with a scalpel.

14 / REASSEMBLE CASE

Once all the panels are covered, you can reassemble the case. Take care when doing this job, as some sections of vinyl may be located in places that make contact when fixing them back together, potentially pulling it off.

15 / CUT OUT FAN GRILLES

Depending on the cooling arrangement, you may need to cut out space for fan grilles into the vinyl. Unless the grille holes are large, it will be extremely difficult, not to mention time-consuming, to cut out the holes individually, so it's best to cut around the whole grille instead. CPC

DOWNLOAD FROM WWW.ASUS.COM/CAMPAIGN/REALBENCH

CUSTOM PC REALBENCH 2015

in association with ASUS

Give your PC a workout with our new benchmark suite, and see how your rig compares to other readers' machines

BENCHMARK YOUR PC

Download the benchmarks from www.asus.com/campaign/Realbench and, before you run them, disable any power-saving technologies in your BIOS that change your CPU clock speed, or the leaderboard won't record your overclock frequency properly. To post a score on the leaderboard, go to Save Upload File in the RealBench 2015 app's Results menu, and save your results in an RBR file. You need to select Offline Uploads on the leaderboard site, sign up for an Asus account and upload your file.

Gimp

We use Gimp to open and edit large images. Unlike our previous Gimp test, this one uses more than one CPU core, although it's still more sensitive to clock speed increases than to more CPU cores.

Handbrake H.264 video encoding

Our heavily multi-threaded Handbrake video encoding takes full advantage of many CPU cores, pushing them to 100 per cent load.

LuxMark OpenCL

This GPU compute test is the only synthetic part of our suite, although the renderer is based on the real LuxRender physically based rendering software. As 3D rendering is a specific workload that not everyone will use, and because OpenCL support isn't standard in most software, this section is given just a quarter of the weighting of the other tests in the final score.

Heavy multi-tasking

Our new multi-tasking test plays a full-screen 1080p video, while running a Handbrake H.264 video encode.

Scores

RealBench 2015 breaks down the scores for each test, then gives you a total system score and a percentage reference score.

On an Intel system, the 100 per cent reference score comes from a stock-speed Core i7-4790K, with 16GB of Corsair 2,400MHz DDR3 memory, a 240GB OCZ 150 SSD, an Asus Maximus Gene VII motherboard and an Nvidia GeForce GTX 780 3GB graphics card.

On an AMD system, the 100 per cent reference score comes from a stock-speed A10-7850K APU, with 8GB of Corsair 2,133MHz DDR3 memory, a 256GB Plextor M5 Pro SSD and an Asus A88X-Pro motherboard, using the APU's integrated graphics. CPC

SHOUT OUTS!

Our own dream PC has been knocked off the top spot twice. Congratulations to ian.parry3 and Luke@DinoPC who overclocked their Core i7-5960X chips to 4.6GHz and took the top two spots on the leaderboard. We look forward to seeing Dino PC's effort in next issue's dream PC Labs. If your username is ian.parry3, we'd love to talk to you – email Ben at editor@custompcmag.org.uk

CHROME WARNING

At the moment, Google's Chrome browser flags up the RealBench 2015 download as potentially harmful, and we're aware of this issue. The file is perfectly safe, however – please ignore this warning.

CUSTOM PC REALBENCH 2015 LEADERBOARD

	SYSTEM SCORE	REFERENCE	USERNAME	MOTHERBOARD	CPU	CPU CLOCK	MEMORY	PRIMARY GPU
1	233,375	203.9%	ian.parry3	Asus Rampage V Extreme	Intel Core i7-5960X	4.6GHz	32GB G.Skill 3,200MHz	Nvidia GeForce GTX Titan X
2	219,415	191.71%	Luke@DinoPC	Asus Rampage V Extreme	Intel Core i7-5960X	4.6GHz	16GB Corsair 3,276MHz	Nvidia GeForce GTX Titan X
3	201,446	176%	CustomPC	Asus Rampage V Extreme	Intel Core i7-5960X	4.3GHz	16GB Corsair 2,666MHz	Nvidia GeForce GTX Titan X
4	197,964	173%	Carbonleg	Asus X99-E WS	Intel Core i7-5960X	Not reported	32GB Corsair 2,400MHz	AMD Radeon R9 200 Series
5	189,230	165.3%	shadowsrayne	Asus Rampage V Extreme	Intel Core i7-5960X	4.2GHz	32GB Corsair 2,133MHz	Nvidia GeForce GTX 980
6	172,828	151%	mdottwo	Asus Rampage V Extreme	Intel Core i7-5820K	4.4GHz	16GB G.Skill 2,766MHz	AMD Radeon R9 200 Series
7	165,512	144.6%	Penfold	Asus X99-Deluxe	Intel Core i7-5820K	4.5GHz	32GB Corsair 2,333MHz	AMD Radeon R9 200 Series
8	163,650	143%	shaunhanson	MSI X99S SLI Plus	Intel Core i7-5820K	Not reported	16GB Corsair 2,133MHz	Nvidia GeForce GTX 980
9	163,400	142.7%	andy	MSI X99S Gaming 7	Intel Core i7-5820K	4.4GHz	16GB Corsair 2,666MHz	Nvidia GeForce GTX 980
10	161,503	141.1%	Chris_Waddle	Asus Rampage IV Black Edition	Intel Core i7-4930K	4.72GHz	16GB Corsair 2,400MHz	Nvidia GeForce GTX 780 Ti
11	155,685	136%	MAQ	Asus Rampage V Extreme	Intel Core i7-5930K	Not reported	32GB Corsair 2,133MHz	Nvidia GeForce GTX 970
12	148,641	129.9%	claire.york83	Asus X99-S	Intel Core i7-5820K	4GHz	16GB G.Skill 2,666MHz	AMD Radeon HD 7900 Series
13	148,066	129.4%	andrew_mcse	Asus Rampage IV Black Edition	Intel Core i7-4930K	4.3GHz	32GB G.Skill 1,333MHz	AMD Radeon R9 200 Series
14	146,635	128.1%	hutch	Asus Rampage IV Extreme	Intel Core i7-4930K	4.5GHz	32GB Kingston 1,333MHz	AMD Radeon R9 200 Series
15	146,123	127.7%	Samual	Asus Maximus VI Extreme	Intel Core i7-4790K	4.95GHz	16GB Team Group 2,666MHz	Nvidia GeForce GTX 780
16	145,751	127.4%	sparrowhawks	Asus Rampage V Extreme	Intel Core i7-5820K	Not reported	16GB Kingston 2,400MHz	Nvidia GeForce GTX 980
17	143,892	125.7%	robert_a_inglis	Asus Rampage V Extreme	Intel Core i7-5930K	Not reported	16GB Corsair 3,000MHz	AMD Radeon HD 5800 Series
18	139,757	122.1%	dainye	Asus P9X79 Pro	Intel Core i7-3930K	4.6GHz	8GB Kingston 1,600MHz	AMD Radeon HD 7900 Series
19	136,031	118.9%	Karol	Asus Z97-A	Intel Core i7-4790K	4.8GHz	16GB Corsair 2,400MHz	Nvidia GeForce GTX 970
20	135,075	118.0%	Melek	Asus Maximus VI Formula	Intel Core i7-4790K	4.8GHz	16GB Kingston 1,600MHz	Nvidia GeForce GTX 780 Ti

Readers' Drives

Pandora's Purple Box

Dave Alcock saw BitFenix's slimline Pandora chassis, and set himself the challenge of modding it to accept a large graphics card, as well as a custom water-cooling loop

/MEET THY MAKER

Name Dave 'davido_labido' Alcock

Age 26

Location Nottingham

Occupation Engineering team for DHL

Main uses for PC Gaming

Likes Junk food, Dr Pepper, beer , jalapeños , cider lollies, comedy

Dislikes Tomatoes, mustard, alcohol-free beer, soap operas

CPC: What originally inspired you to build Pandora's Purple Box?

Dave: I've made quite a few builds using BitFenix cases, such as the Shinobi XL and the Phenom, and I've always had good results, so when the BitFenix UK rep asked me if I would like to use the new Pandora case, I answered with an instant yes. I'd only seen a few pictures of the case at the time and it intrigued me. I saw that it was aimed more towards air cooling, or all-in-one liquid coolers, so I thought I would show off what it could do with a bit of creativity.

I wanted to present the BitFenix Pandora in a way that hadn't been seen, using a full-sized graphics card and a custom water-cooling loop. This type of setup is pretty much the exact opposite of the purpose for which BitFenix made the case, so it gained quite a lot of attention. I wanted the PC to have a sleek loop in a relatively small case that looked good. The inspiration for the colour scheme actually came from BitFenix's cable extensions. I just saw white and purple ones, and thought it would be a good colour scheme to use.

The name 'Pandora's Purple Box' is a far more family-friendly name than what I was originally going to call it. I thought it would get a little bit of a giggle from the people who knew me, as they know my sense of humour. Quite a few people liked the name when I mentioned it to them, so it just kind of stuck. It works though – it's a Pandora, it's a box and it has purple in it!

CPC: What specs did you choose?

Dave: For this build I had help from Asus, EKWB, BitFenix, CM Storm, HyperX, E22 and Mayhems, so I was able to get some great gear. For the motherboard, I used an Asus Z97 Gryphon, as I wanted to spray the Thermal Armor. I also wanted a large graphics card, so I chose the Asus R9 290 DirectCU II, along with an EKWB water-cooling block for it, which looks amazing, and it really shows off the card's size. I also used HyperX RAM and SSDs as usual, as I've always found HyperX gear reliable, and it performs the way I need. The case, PSU and fans were all from BitFenix UK, which wanted to support me as much as possible.

CPC: What difficulties did you come across?

Dave: I was pretty much prepared for most of the difficulties I came across before I started the build. The main one issue was that the graphics card was far wider than the case. I did know the card's size when I ordered it, but I didn't realise the fit would be quite so tight. I managed to fit the card in the case by installing it at quite a sheer angle, using a PCI-E riser cable.

I also wasn't prepared for the struggle when mounting the radiators, or the cable management. I inverted the case, so all the case's cable management space was gone. As such, I had to remake nearly all the cables to make sure they were only as long as necessary. Inverting the case also meant the fan holes weren't in the same places as before, so I had to drill new ones to enable me to add the radiators.

CPC: What materials did you use?

Dave: I always use a lot of acrylic in builds, and this one was no different. I made an acrylic backplate to hide the cables and the bracket for the angled GPU. I also used some paint pens and quite a lot of spray cans.

Inverting the case was the first mod of the build. The graphics card needed to be fitted in a certain way, which just wasn't possible in a an unmodded Pandora. I drilled out all the rivets and completely spun the case around. Other mods included cutting the Pandora's front panel to show off its screen better, laser-etching the sponsors' logos into the side panel and cutting a bigger window to show off the components. I also made sure all the colours matched, so I had the case powder-coated and then sprayed all the other parts.

CPC: What tools and machinery did you use?

Dave: As always, I used a mixture of

SEE THE FULL PROJECT LOG:
http://tinyurl.com/PandorasPurpleBox

hand tools and power tools. My trusty rotary tool and my junior hacksaw did a lot of work, as did my drill. This time I also had help from **www.e22.biz** – I went to the E22 workshop and used its laser to etch the sponsors' logos into the side panel, which looked amazing.

CPC: How long did it take you to complete the project?

Dave: Managing my time is really hard, as I work away from home a lot, so I have to cram any modding into a small amount of time. This PC was still being built the day before I took it to Insomnia 54 to be placed

SYSTEM SPECS

CPU Intel Core i5-4690k overclocked to 4.4GHz
Graphics card Asus Radeon R9 290 DirectCU II 4GB
Memory 16GB (4 x 4GB) HyperX Fury White
Case BitFenix Pandora
Motherboard Asus Gryphon Z97 Armor Edition
Storage 2 x 120GB HyperX 3K SSD
PSU BitFenix Fury 650W
Cooling EKWB custom loop

on the OCUK stand. I think the staff were quite worried, and pleasantly surprised when I actually turned up with a completed build.

It received a lot of compliments throughout the weekend, including some from legends such as 8Pack, so I was very happy!

CPC: What did you learn from the build process?

Dave: With every build I gain more experience and learn new tricks and skills. For instance, with this one, I learned some far better ways to achieve a decent finish with a spray can, and I learned how to use hard-line tubing more effectively too. I also learned that powder coating can be laser etched,

resulting in an amazing finish. I was the first person to approach E22 with this idea, and we weren't sure it was going to work, but E22 has since done some amazing designs using the same method, so it's great to see companies have learned from this project too.

CPC: Are you happy with the end result, and is there anything you'd do differently if you built it again?

Dave: I'm extremely pleased with the end result, I think it's certainly one of my best builds so far – the positioning of the graphics card and the colour scheme work really well, and it's garnered a lot of attention at events.

There are a few parts that aren't 100 per cent perfect, due to the fact that I ran out of time, but they're minor parts that usually go unnoticed. CPC

BE A WINNER

To enter your machine for possible inclusion in Readers' Drives, your mod needs to be fully working and, ideally, finished based in the UK. Simply log on to **www.bit-tech.net** and head over to the forums. Once you're there, post a write-up of your mod, along with some pics, in the Project Logs forum. Make sure you read the relevant rules and advice sticky threads before you post. The best entrant each month will be featured here, where we'll print your photos of your project and also interview you about the build process. Fame isn't the only prize; you'll also get your hands on a fabulous selection of prizes – see the opposite page for details.

THANKS FROM DANIEL

Justin and Katherine at In Win, Derick and Niko at EK, Gareth at Asus, Katharina at Be Quiet! UK, Justin and Shaun at Parvum, and Nate at E22. I would also like everyone to take two minutes to think about the guys at Specialtech, who helped, but the company is sadly no longer with us. These guys gave me my first leg-up, and it's a real shame to see them go, so I'd like to give a really massive thank you to Ayd, Rootz and Steve for all you've done for me and the UK water-cooling community. We miss you.

Win all these prizes!

We've teamed up with some of the world's leading PC manufacturers and retailers to offer this great range of prizes to each lucky Readers' Drives winner. If your creation is featured in the magazine then you'll walk away with all of the prizes listed on this page, so get in your entries!

Corsair graphite Series 230T case and RM 550w Modular power supply

TOTAL VALUE £150 inc VAT / **MANUFACTURER** www.corsair.com

Corsair believes that a great PC starts with a great case. The Corsair Graphite Series 230T is a compact expression of this core philosophy. With stylish looks and a choice of three different colours, it packs in a remarkable number of features to provide builders with tonnes of room for expansion and amazing cooling potential. Like all Corsair cases, it's built using the finest materials and finished to the highest standards, so it will withstand several years of upgrades. Plus, to make sure it stand outs from the crowd, the 230T features Corsair's new Air Series LED high-airflow fans, providing distinctive lighting with low-noise, high-airflow cooling.

Just as a quality case is essential to building a quality PC, a high-performance, a high-quality power supply is also a vital ingredient. The all new RM series has been built from the ground-up to deliver unmatched reliability alongside 80Plus Gold efficiency, and all with the absolute minimum of noise. It uses specially optimised quality parts to reduce sound at the component level, and it's completely silent below 40 per cent load, thanks to its Zero RPM fan mode. It's also fully modular, allowing for the maximum amount of flexibility during installation. With a Corsair Graphite 230T case and an RM 550W Modular power supply at the heart of your build, you'll have the foundations for a truly awesome gaming machine.

Mayhems coolant and dyes

VALUE £50 inc VAT / **MANUFACTURER** www.mayhems.co.uk

Cooling performance is only one part of the equation when it comes to kitting out your rig with custom water-cooling gear. The other major bonus is that all those tubes and gleaming fittings just make your PC look damn sexy, and they look even better when they're pumped full of fancy coloured coolant. As such, we're particularly pleased to have the folks at Mayhems now on board with Readers' Drives; they're currently offering two 1-litre bottles of Mayhems' Pastel Ice White coolant, along with a selection of five dyes, so you can choose the colour that best complements your PC. Check out the blue coolant in our own mini PC mod on the cover of Issue 109 for an example of what's possible with some Mayhems coloured coolant.

Phobya Modding Kit

VALUE £50 inc VAT **MANUFACTURER** www.phobya.com, www.aqua-tuning.co.uk

The Phobya modding kit is designed with the modder in mind, offering great value for money and quality products. The kit includes Nano-G 12 Silent Waterproof 1,500rpm multi-option fans, which use an innovative fan-blade design. As standard, the fans include braided black cables to keep your case looking as neat as possible. The fans are also supplied with a special cable that lets you run the fan at 5V rather than 12V, reducing the noise emitted in order to help you to build a silent system.

The kit also includes the 60cm Phobya 3-pin Molex to 4x 3-pin Molex Y-cable. This pre-braided extension cable gives you extra routeing options in your case, and it also enables you to run up to four fans from one compatible motherboard header. Meanwhile, the Phobya SATA 3 cables included in the kit offer the same great quality braiding as the rest of the Phobya range, while also securing your connection with latched connectors. As well as this, the kit includes the Phobya SlimGuide Controller, which gives you the option to vary the speed of other fans in your case, while the Phobya TwinLEDs let you shine a light on your mods.

Folding@Home

Join our folding team and help medical research

Folder of the month / We catch up with: Maglor

CPC: So who is Maglor?
Maglor: My name is Rick and I'm an engineering team leader for a multinational pet food manufacturer.

CPC: Why did you start folding?
Maglor: I first discovered Folding@home on my PS3 several years ago. I used to be a big console fan, but one of my former apprentices converted me to a PC gamer a couple of years ago, and there's no looking back. When I got the bug for PC building, I looked for ways to test my builds, and rediscovered folding in early 2015. My self-built PC generated more points in a week than my PS3 managed in around six years.

CPC: What excites you most about folding?
Maglor: It serves as a tool to check various overclocks and configurations, but it also helps research cancer and various degenerative diseases. I can delight in eking out as much power as possible from my equipment while maintaining stability, and also feeling good that I'm contributing towards scientific research that may one day help millions of people.

CPC: How many PCs do you have folding?
Maglor: Just my gaming rig, which has a Core i5-4690K overclocked to 4.6GHz with a Corsair H100i AIO, along with two MSI GeForce GTX 970 cards.

CPC: Do you intend to keep up your current production rate?
Maglor: Most certainly. I'm selling my 970s and replacing them with a GTX 980 Ti (and hopefully a second 980 Ti towards the end of the year, plus custom water cooling – I'll be interested to see how this change affects my production. I'll also be upgrading my CPU at some time this year.

CPC: Any tips for fellow team members?
Maglor: Ensure there's good ventilation for your equipment if you're running it 24/7. I leave the windows open and have a tower fan running in the room to dissipate the heat – I don't allow any component to get above 65°C. Also, don't use the maximum possible overclock for everyday use: I have different profiles saved for different tasks.

CPC: What's your worst folding experience?
Maglor: My electricity bill has gone up by around £30 a month, due to me folding 80 per cent of the time.

CPC: And the best?
Maglor: Probably making it to the top 100 in the **Custom PC** team rankings!

Finally, I'd just like to say that while the entire magazine is fantastic, I want to give a special shout-out to Rick Lane. His articles are always well thought out and he's one of the few reviewers I actually listen to when it comes to considering the gaming industry.

STATS

Team rank 80
World rank 3,310
Score 29,954,333
Work units 821
Daily points average 440,117

TOP FOLDERS: This month's shout-outs go to Wilding2004, billssteam and BeezaBob. If you fold under any of these names, email **folding@custompcmag.org.uk**

WHAT IS FOLDING?

Folding@home uses the spare processing cycles from your PC's CPU and graphics cards for medical research. You can download the client from **http://folding.stanford.edu** and our team's ID is 35947. Once you pass a significant milestone, you'll get your name in the mag. You can also discuss folding with us and other readers on the **www.bit-tech.net** forums.

MILESTONES THIS MONTH

USERNAME	POINTS MILESTONE
Curtis_Perdue	20000
AJJackson1	30000
bibimbap	30000
callumtho	30000
mick750Ti	30000
tallandgentle33uk	30000
whiskeyecho	40000
Philhasnoidea whathe\\'sdoing	50000
pig_farmer_uk	50000
JamieRStone	70000
antiHero	100000
Catseyes	100000
kerbdog1	100000
meddy2065	100000
TimmyH	100000
Davith	300000
random_dave	300000
TheTomBoy	300000
davm64	400000
MetallicGloss	400000
RougeNikov	400000
	400000
Zaratoustra	400000
Glyn_Mason	500000
LboroSlider	500000
wew	600000

USERNAME	POINTS MILESTONE
Bob_D	700000
Bobthetoolnut	700000
MikePreston	700000
elpaulio	800000
RaistlinRTCW	800000
Lethaertes	900000
Chrissebooboo	1000000
Lunnbow	1000000
slowpurple	1000000
Werewolf_Legs	1000000
Adam_S_James	2000000
CCHS	2000000
Damien_Tanner	2000000
Johnny2Bad	2000000
robertmather	2000000
skippyadam	2000000
BondyBoy	3000000
kcanti	3000000
techknowledgey	3000000
TIG	3000000
Trunkey	3000000
andboo1	4000000
RDL_Mobile	4000000
MarkVarley	5000000
matgsi	5000000
Scammelio	5000000
Taffers1966	5000000

USERNAME	POINTS MILESTONE
ZeDestructor	5000000
Ken_Swain	6000000
Skidder	6000000
Tommye123	6000000
Uncle_Fungus	6000000
adbygrave	7000000
billssteam	7000000
crazystuntman	7000000
daxchaos	7000000
Bedders	8000000
gupsterg	8000000
madmatt1980	8000000
Mem	8000000

USERNAME	POINTS MILESTONE
SP1	8000000
Simlec	9000000
toothytech	9000000
Andy_J	10000000
killtothis	10000000
MattEngr	10000000
Dickie	20000000
Maglor	20000000
Portchylad	20000000
Petaflops	40000000
Wilding2004	50000000
Roveel	70000000
HHComputers	200000000

THE NEXT OVERTAKE

WORLD RANK	TEAM NAME	POINTS	DAILY POINTS AVERAGE	TIME UNTIL OVERTAKE
2	[H]ardOCP	50,120,552,815	7,902,755	10.6 years
5	www.overclockers.com	21,978,622,225	12,125,294	3.3 years
7	TSC! Russia	17,592,113,108	14,679,026	1.4 years
8	Custom PC & bit-tech	16,599,852,728	16,558,034	0
20	LinusTechTips_Team	5,366,372,232	24,343,688	4 years

TOP 20 OVERALL

RANK	USERNAME	POINTS	WORK UNITS
1	Nelio	2,357,697,677	118,156
2	DocJonz	1,134,031,536	173,439
3	coolamasta	728,129,815	166,095
4	Scorpuk	577,860,269	15,227
5	StreetSam	563,631,744	90,064
6	piers_newbold	478,789,235	39,884
7	Dave_Goodchild	461,385,406	118,589
8	johnim	365,191,467	80,158
9	PC_Rich	345,669,816	74,325
10	Slavcho	292,223,224	32,964
11	Lordsoth	257,620,346	92,458
12	HHComputers	256,034,025	15,488
13	phoenicis	250,044,587	95,660
14	The_M2B	248,368,022	55,864
15	Wallace	212,477,027	6,204
16	zz9pzza	211,014,628	15,794
17	TheFlipside	178,966,724	20,726
18	Ben_Lamb	166,053,146	2,891
19	Laguna2012	155,380,246	16,927
20	Desertbaker	152,562,665	14,240

TOP 20 PRODUCERS

RANK	USERNAME	DAILY POINTS AVERAGE	OVERALL SCORE
1	HHComputers	2,149,946	256,034,025
2	DocJonz	1,785,976	1,134,031,536
3	piers_newbold	1,145,285	478,789,235
4	PC_Rich	950,262	345,669,816
5	Scorpuk	860,523	577,860,269
6	Slavcho	738,000	292,223,224
7	Wilding2004	631,147	59,618,260
8	johnim	592,775	365,191,467
9	Dickie	464,541	29,261,348
10	The_M2B	452,964	248,368,022
11	Roveel	451,678	75,219,156
12	Desertbaker	439,351	152,562,665
13	coolamasta	430,863	728,129,815
14	Lordsoth	416,097	257,620,346
15	Nelio	374,335	2,357,697,677
16	Maglor	353,786	22,207,965
17	killtothis	233,047	10,362,896
18	KevinWright	208,769	150,632,157
19	TheFlipside	207,056	178,966,724
20	apeman556	199,805	109,835,200

JAMES GORBOLD / HARDWARE ACCELERATED

FURY X IS A HUGE STEP FORWARDS FOR AMD

But it's not the comeback product that's required, argues James Gorbold

AMD's market share of the highly competitive GPU business has been in the doldrums since 2005, in decline since early 2010 and in serious trouble since Q3 2014, when Nvidia introduced the GTX 980 and 970. If you don't believe me, just Google it and look at the graphs.

In my opinion, the primary cause of this decline of market share in recent years has been a lack of innovation; unlike Nvidia, which has developed several new architectures, AMD has kept tweaking the aging Graphics Core Next (GCN) architecture that it first released way back in 2011.

You can see this pattern playing out again in AMD's newly launched R9 300 series of GPUs, of which four out of the five chips are based on the older 1.0 and 1.1 versions of GCN and as a result, simply aren't competitive with Nvidia's GeForce latest 900-series graphics cards.

However, over the past few months, AMD's PR machine has been building up hype about its new Fury X (see p18), a new high-end graphics card billed as a Titan X killer thanks to its use of high-bandwidth memory (HBM). This new type of memory is a big deal for GPUs, as it provides significantly more bandwidth than traditional GDDR5, while consuming far less power, as it runs at a lower clock speed and doesn't require a complex memory controller inside the GPU.

HBM is also good news for graphics card design, as it's physically in the same package as the GPU, so it's easier to power and keep cool, rather than sitting in separate modules spread over the PCB. The only downside to HBM is that it's currently only available in up to 4GB quantities, noticeably smaller than the frame buffer provided by other high-end cards such as the 390X's 8GB, Titan X's 12GB or the 980 Ti's 6GB of memory.

As a result of HBM, Fury X breaks the mould for high-end graphics cards, with a very short PCB of just 195mm in width, compared with the more usual 270mm or so you'd expect a high-end graphics card to measure. It also features a very quiet Cooler Master liquid-cooling system as standard, with the pump integrated onto the waterblock, all kept cool by a 120mm radiator.

It's all good stuff, but again Fury X is still saddled with a GPU based on the GCN architecture, although it's at least the improved 1.2 version. As a result, despite having a huge number of stream processors – 4,096 to be precise, far more than the 390X, which has 2,816 – the new GPU is arguably imbalanced. For instance, the back-end still features the same 64 ROPs as the 390X, providing a performance bottleneck in games with lots of final-output blending or lots of anti-aliasing.

It's all good stuff, but again Fury X is still saddled with a GPU based on the GCN architecture

The end result is that, when Fury X was released this month, it failed to be a Titan X killer – in **CPC**'s tests, it's pretty much level with the 980 Ti at 4K, let alone the Titan X, and a little behind it at lower resolutions. The Fury X is competitive, yes, but it's not a Titan X killer. AMD needed to trounce Nvidia in this round, and it hasn't managed it.

Ultimately, while Fury X has some strong talents, such as low noise and low power consumption, its performance isn't enough to take back the headlines.

In short, it's a good graphics card, but not the great comeback graphics card AMD so desperately needed to start taking back market share from Nvidia. CPC

James Gorbold has been building, tweaking and overclocking PCs ever since the 1980s. He now helps Scan Computers to develop new systems.

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